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MOREY'S ARITHMETICS

ADVANCED
ARITHMETIC

CHARLES SCRIBNER'S SONS

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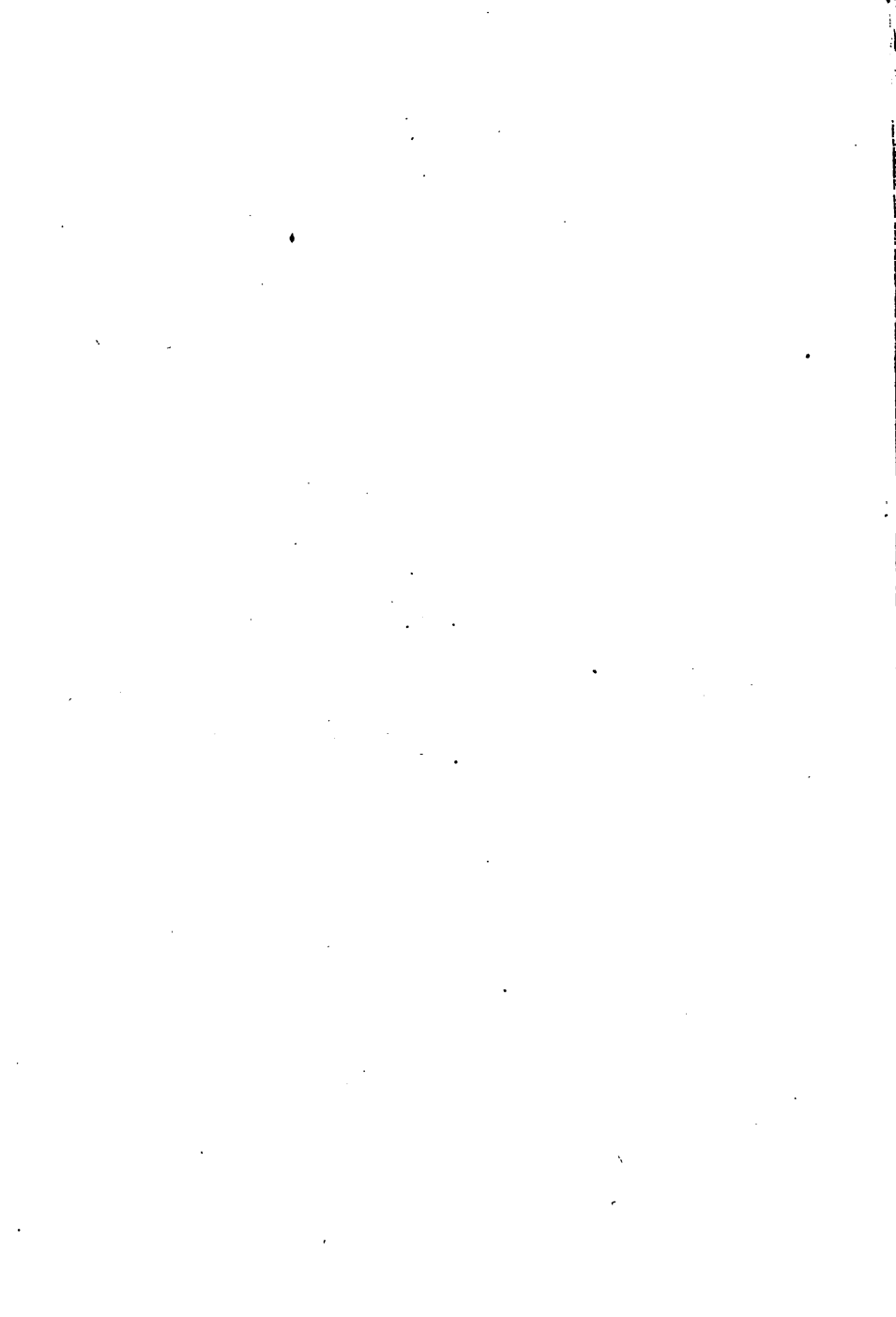
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Ethel Thurston
Rooms



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ADVANCED ARITHMETIC



MOREY'S ARITHMETICS

ADVANCED ARITHMETIC

BY

CHARLES W. MOREY, M.A.

**MASTER OF HIGHLAND SCHOOL
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CHARLES SCRIBNER'S SONS

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PREFACE

THE object of the series of text-books of which *Advanced Arithmetic* is a part is threefold : —

I. To secure accuracy and facility in the mechanics of number. To accomplish this result there is a continuous presentation of the fundamental processes with integers and with fractions, both common and decimal.

II. To relate the use of number to the affairs of everyday life. This requires the solution of problems in household and school economics, in the affairs of the playground, the workshop, and the farm, and a study of conditions existing in the business world.

III. To develop a power of insight and analysis which shall render pupils resourceful and self-reliant. This involves the introduction of many problems requiring the use of more than a single process in their solution, and drawn from a great variety of sources, both within and without the experience of the pupil. A foundation is thus laid for work in mathematics beyond grammar school grades.

Some subjects ordinarily included in grammar school courses are purposely omitted because it is believed that the mastery of a few subjects is the sane and wise method of procedure in the development of mathematical power. Quality, not quantity, of work is of prime importance in training young pupils.

The subject matter of Advanced Arithmetic is so arranged that pupils leaving school before the completion of the regular course are given opportunity to acquire some knowledge of practical business methods.

The author wishes to acknowledge his indebtedness to all who have assisted in the preparation of the manuscript, and especially to Mr. Myron T. Pritchard, Master of the Everett School, Boston, Massachusetts, for wise counsel and criticism.

C. W. M.

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ADVANCED ARITHMETIC

PART I

INTERMEDIATE ARITHMETIC

NOTATION AND NUMERATION

1. How many places are required to write ten in figures? One hundred? One thousand? Ten thousand? One hundred thousand? One million? Ten million? One hundred million?

2. Why is our system of writing numbers called a decimal system?

3. Using the figures 2, 8, 3, 9, 6, write the largest number possible. Read it.

4. Using the same figures, write the smallest number possible. Read it.

5. Write a number occupying five places which has no tens and no hundreds. Read it.

6. Using the figures 3 and 8, and as many 0's as necessary, write :

(1) A number in which the left-hand 3 has ten times the value of the right-hand 3.

(2) A number in which the left-hand 3 has one hundred times the value of the right-hand 3.

(3) A number in which the left-hand 3 has one thousand times the value of the right-hand 3.

7. Compare the values of the 7's in 77; in 707; in 770; in 7007; in 7070; in 70,007.

The value of a figure in a number depends upon two things:

- (1) Its value in the scale 1, 2, 3, 4, 5, 6, 7, 8, 9.
- (2) Its place in the number.

The figures 1, 2, 3, 4, 5, 6, 7, 8, 9, are called significant figures.

8. Keeping in mind the values of the significant figures, tell how many times the value of the right-hand figure is represented by the left-hand figure in 42; in 930; in 603; in 5010; in 8002.

9. Write a number which has the figure 2 in the units' place, and a figure in the tens' place which in that place expresses forty times as much.

Write in figures:

1. Seven hundred eight.
2. Nineteen thousand forty-two.
3. Sixty thousand five hundred nine.
4. Two hundred forty-six thousand three hundred sixty.
5. Eight hundred ten thousand six hundred forty-nine.
6. Three million one hundred eighty-four thousand two hundred four.
7. Ninety-one million fifty-seven thousand five hundred.
8. Five hundred six million.

9. Four hundred eighteen million twenty-eight thousand seven hundred thirty-two.

10. Six hundred million three hundred thousand one hundred.

Separate into groups, read aloud, and then write in words:

- | | | | |
|-------------|------------|-------------|-------------|
| 1. 386 | 2. 38600 | 3. 3086 | 4. 386000 |
| 5. 308600 | 6. 3860 | 7. 30806 | 8. 308060 |
| 9. 1309 | 10. 309 | 11. 2007 | 12. 10008 |
| 13. 4007025 | 14. 139300 | 15. 247080 | 16. 7647200 |
| 17. 340600 | 18. 40706 | 19. 3008075 | 20. 400800 |

ROMAN NOTATION AND NUMERATION

Letters	I	V	X	L	C	D	M	Roman
Values	1	5	10	50	100	500	1000	Arabic

By combining these letters according to these rules, any number may be written :

I. When a letter is followed by the same letter or by one of less value, add the values of the letters.

Thus, II = 2; XX = 20; XV = 15; LX = 60.

II. When a letter is followed by one of greater value, subtract the letter of less value from the letter of greater value.

Thus, IV = 4; IX = 9; XL = 40; CD = 400.

1. Write 1776 in Roman notation.

$$1776 = 1000 + 700 + 70 + 6$$

$$M + DCC + LXX + VI = MDCCLXXVI$$

Write in letters :

- | | | | |
|----------|----------|----------|----------|
| 2. 14 | 3. 25 | 4. 88 | 5. 54 |
| 6. 67 | 7. 89 | 8. 98 | 9. 5 |
| 10. 50 | 11. 55 | 12. 500 | 13. 505 |
| 14. 550 | 15. 555 | 16. 1620 | 17. 1680 |
| 18. 1700 | 19. 1840 | 20. 1900 | 21. 1911 |

22. Write MDCLXVI in Arabic notation.

$$\text{MDCLXVI} = \text{M} + \text{DC} + \text{LX} + \text{VI}$$

$$1000 + 600 + 60 + 6 = 1666$$

Write in figures :

- | | | |
|-----------|------------|-------------|
| 23. XIX | 24. XXVIII | 25. XLIV |
| 26. LXX | 27. XCIX | 28. MD |
| 29. MM | 30. MCM | 31. MDCC |
| 32. MCDLX | 33. MDCXX | 34. MDLXXIX |
| 35. MLXVI | 36. MCMX | 37. MCMXVII |

A dash over a letter increases its value one thousand fold. Thus, $\overline{\text{X}} = 10,000$; $\overline{\text{L}} = 50,000$.

38. Write these letters so that they shall represent 1000 times their ordinary value: I V C D M

39. Where are Roman numerals used?

Numbers may be expressed in three ways:

(1) by words; (2) by figures; (3) by letters.

40. In each of these three ways express your age; the number of days in a week; the number of months in a year; the number of weeks in a year; the number of minutes in an hour; the number of hours in a day; this page of the book; this year; the year in which you were born.

DRILL TABLE

5

ADDITION

Oral

6	2	7	9	3	1	0	4	8	5
---	---	---	---	---	---	---	---	---	---

Addition is the process of uniting two or more numbers into one number.

What is the sign of addition? What is it called? What does it show? What name is given to the result in addition?

Add 2 to each number in the diagram. Add 1; 3; 4; 5; 6; 7; 8; 9.

Find the sum of the numbers in the diagram. Beginning with 1; 2; 3; 4; 5; 6; 7; 8; 9, add the numbers in the diagram.

DRILL TABLE

	A	B	C	D	E	F	G	H	I	J
1.	46	83	86	24	29	72	80	35	27	98
2.	85	77	<u>48</u>	<u>71</u>	33	96	14	79	12	20
3.	19	22	70	65	67	28	51	13	36	94
4.	<u>63</u>	66	64	59	42	50	25	87	58	11
5.	97	18	31	93	56	34	39	52	90	75
6.	92	30	55	<u>47</u>	78	61	73	26	74	49
7.	76	54	99	32	10	15	57	68	81	53
8.	38	41	23	16	84	89	62	60	45	37
9.	40	95	17	88	91	43	21	44	69	82

To each number in the table add 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12.

To each number add 10; 20; 30; 40; 50; 60; 70; 80; 90.

Give the sum of each number in the table and 87. Thus, $87 + 46$; $87 + 40 + 6$; think 127, 133; say 133.

Add other numbers to the numbers in the table.

Find the sum of column A. Of the other columns.

Find the sum of row 1. Of the other rows.

ADDING TWO COLUMNS AT ONCE

Sight

Find the sum, adding both columns at once:

Thus in number 1: 11, 22, 31, 35, 45, 52, 64.

Test by adding down.

1. 12	2. 15	3. 10	4. 14	5. 18	6. 20
7	4	6	3	6	10
10	8	12	7	10	15
4	12	4	8	15	6
9	10	11	10	7	7
11	4	8	12	9	2
6	5	3	11	10	30
5	7	12	8	12	5
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
7. 20	8. 8	9. 50	10. 40	11. 30	12. 25
8	4	5	6	8	10
7	12	7	4	2	7
15	10	20	7	5	3
11	16	6	13	12	16
10	5	4	10	15	4
9	4	9	12	10	8
5	20	15	8	7	12
12	30	8	5	3	15
10	6	20	7	20	5
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>

Beginning with 1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 20; 21, add the numbers in examples 1 to 12.

Why are units written under units, tens under tens, etc., in adding numbers?

NOTE. Pupils should be required to prove work in fundamental processes until accuracy becomes a habit.

WRITTEN EXERCISES

- | | A | B | C | D | E | |
|----|-----|-------|-------|-------|-------|--|
| 2. | 285 | + 374 | + 562 | + 134 | + 658 | Find the sum of
each row; of all the
rows; of each col-
umn; of all the col-
umns. |
| 2. | 497 | + 563 | + 697 | + 878 | + 469 | |
| 3. | 174 | + 481 | + 148 | + 306 | + 542 | |
| 4. | 908 | + 824 | + 437 | + 378 | + 496 | |
| 5. | 734 | + 512 | + 657 | + 498 | + 763 | |

- | | A | B | C | D | E | F |
|-----|-------|---------|---------|---------|---------|--------|
| 6. | \$ 7 | + \$800 | + \$ 70 | + \$749 | + \$ 96 | = \$—— |
| 7. | \$ 89 | + 9 | + 900 | + 60 | + 875 | = —— |
| 8. | \$856 | + 76 | + 6 | + 800 | + 50 | = —— |
| 9. | \$ 80 | + 964 | + 48 | + 8 | + 600 | = —— |
| 10. | \$500 | + 90 | + 788 | + 57 | + 5 | = —— |
| 11. | \$ | + \$ | + \$ | + \$ | + \$ | = \$—— |

Add and test:

- | | | | | |
|-----------|----------|------------|-------------|---------------|
| 1. 29 | 2. 784 | 3. 8437 | 4. 48,950 | 5. 576,432 |
| 92 | 392 | 6985 | 76,899 | 376,498 |
| 87 | 578 | 3800 | 73,204 | 507,837 |
| 96 | 767 | 3749 | 83,562 | 219,857 |
| 69 | 582 | 4527 | 87,420 | 436,849 |
| 56 | 479 | 5873 | 53,978 | 476,375 |
| 80 | 713 | 6734 | 37,739 | 278,135 |
| 82 | 427 | 8472 | 53,028 | 607,364 |
| 6. \$0.64 | 7. \$ 60 | 8. \$ 4.09 | 9. \$ 90.09 | 10. \$ 518.19 |
| .08 | 9 | .26 | 647.38 | 4.00 |
| .05 | 409 | 37.68 | .67 | 2753.80 |
| .47 | 76 | 5.34 | 4.87 | 23.47 |
| .29 | 8 | .08 | 85.07 | 762.89 |
| .35 | 847 | .76 | .29 | 4.68 |
| .87 | 2256 | 56.34 | 918.60 | 2233.92 |

PROBLEMS

Written

1. Find the total area of these possessions of the United States: Alaska, 590,844 square miles; Guam, 210 square miles; Hawaii, 6499 square miles; Panama Canal Zone, 474 square miles; Philippine Islands, 115,026 square miles; Porto Rico, 3435 square miles; and the Tutuila Group, 77 square miles.

2. In one month Mr. Blanchard paid \$17.50 for rent, \$14.87 for groceries, \$12.68 for provisions, \$2.94 for milk, \$1.50 for ice, \$3.75 for shoes, \$7.55 for clothing, and \$3.29 for other expenses. What was the total?

TABLE OF ELECTRIC RAILWAYS IN THE UNITED STATES IN 1908

	NO. OF COMPANIES	MILES OF TRACK	NO. OF CARS
New England states	140	5,390	15,210
Eastern states	460	12,063	35,951
Central states	354	14,723	24,350
Southern states	93	1,975	3,773
Western states	205	6,096	9,932

3. Find the total number of companies; miles of track used; cars operated.

4. There are in the United States 148 streams with a navigable length of 5305 miles flowing into the Atlantic, 54 with a navigable length of 7641 miles flowing into the Gulf, 53 with a navigable length of 11,483 miles flowing into the Mississippi, 2 with a navigable length of 315 miles flowing into Canadian waters, and 38 with a navigable length of 1606 miles flowing into the Pacific. Find the total number of navigable streams. The total number of miles navigable.

SUBTRACTION

Oral

10	Subtraction is the process of taking one number from another, or of finding the difference between two numbers.
13	
16	What is the sign of subtraction? What is it called? What does it show?
19	What is the minuend?
14	What is the subtrahend?
17	What is the result of subtraction?
17	How is work in subtraction tested?
12	Subtract 2 from each number in the diagram.
12	Subtract 3; 4; 5; 6; 7; 8; 9.
18	From the numbers in the drill table on page 5, take 2; 4; 6; 8; 1; 3; 5; 7; 9.
15	From 100 take each number in the drill table.
11	Give the difference between 48 and the numbers in the drill table. Between other numbers and the numbers in the drill table.

ADDITION AND SUBTRACTION

Sight

Give the sum and the difference of:

1.	60	40	70	30	80	50	90	60	80	50
	32	17	45	18	31	23	54	46	39	15
	<u>26</u>	<u>53</u>	<u>25</u>	<u>12</u>	<u>49</u>	<u>27</u>	<u>36</u>	<u>84</u>	<u>41</u>	<u>35</u>
2.	44	57	36	82	75	62	46	57	54	72
	35	28	19	38	36	29	18	38	29	33
	<u>9</u>	<u>17</u>	<u>17</u>	<u>44</u>	<u>30</u>	<u>33</u>	<u>28</u>	<u>19</u>	<u>25</u>	<u>29</u>
3.	81	84	45	53	65	85	75	47	63	92
	27	45	18	27	46	57	28	29	26	57
	<u>54</u>	<u>19</u>	<u>27</u>	<u>27</u>	<u>52</u>	<u>53</u>	<u>47</u>	<u>19</u>	<u>13</u>	<u>29</u>
4.	82	61	74	76	85	53	64	75	43	93
	53	37	39	48	28	19	28	47	18	39
	<u>54</u>	<u>28</u>								

Solve:

- | | |
|---------------------|----------------------|
| 5. $76 - 22 + 17$ | 6. $26 + 73 - 59$ |
| 7. $84 + 22 - 19$ | 8. $67 - 29 + 68$ |
| 9. $27 + 55 - 36$ | 10. $48 + 36 - 39$ |
| 11. $129 - 64 + 28$ | 12. $73 - 25 + 46$ |
| 13. $92 - 36 + 57$ | 14. $55 + 38 - 46$ |
| 15. $90 - 38 + 59$ | 16. $120 + 82 - 36$ |
| 17. $79 + 29 - 69$ | 18. $153 - 69 + 118$ |
| 19. $60 - 27 + 48$ | 20. $115 - 49 + 57$ |
| 21. $76 - 37 + 67$ | 22. $139 + 65 - 49$ |
| 23. $100 - 22 + 78$ | 24. $111 - 77 + 88$ |

WRITTEN EXERCISES

Find differences, and test the work:

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>
1.	753	384	276	392	432	548	653
	<u>347</u>	<u>159</u>	<u>98</u>	<u>37</u>	<u>184</u>	<u>193</u>	<u>579</u>
2.	700	900	600	800	400	200	300
	<u>351</u>	<u>243</u>	<u>108</u>	<u>356</u>	<u>297</u>	<u>73</u>	<u>132</u>
3.	1762	3475	1432	3649	3987	5427	2731
	<u>981</u>	<u>1956</u>	<u>666</u>	<u>1785</u>	<u>2898</u>	<u>3069</u>	<u>956</u>
4.	9000	8000	3000	1000	7000	2000	6000
	<u>347</u>	<u>652</u>	<u>283</u>	<u>187</u>	<u>1284</u>	<u>953</u>	<u>2243</u>

5. How is the minuend found when the subtrahend and the remainder are given?

6. How is the subtrahend found when the minuend and the remainder are given?

Find the missing term :

MINUEND	SUBTRAHEND	REMAINDER	MINUEND	SUBTRAHEND	REMAINDER
7. 637	150	?	8. ?	\$1.96	\$3.71
9. ?	325	187	10. \$6.42	\$2.87	?
11. 476	?	232	12. \$5.50	?	\$2.73

13. From 9000 take 9; 90; 900; 99; 909; 990; 999.

Solve: .

- | | |
|-----------------------|-------------------------|
| 14. \$12.87 — \$9.16 | 15. \$129.37 — \$56.84 |
| 16. \$27.63 — \$18.87 | 17. \$58.74 — \$29.38 |
| 18. \$14.38 — \$6.85 | 19. \$112.49 — \$60.82 |
| 20. \$19.75 — \$9.88 | 21. \$378.50 — \$195.84 |
| 22. \$10.08 — \$3.20 | 23. \$632.70 — \$360.95 |

PROBLEMS

Written

1. The height reached by an aviator is 7912 feet. This is how many feet more than a mile (5280 feet)?

2. Mt. Everest is 29,002 feet high. This is how much more than five miles?

The area of the Great Lakes in square miles is: Superior, 31,200; Huron, 23,800; Michigan, 22,450; Erie, 9960; Ontario, 7240.

3. What is the difference in area between Lake Superior and each of the other lakes?

4. How many more square miles in Lake Huron than in Lake Ontario?

5. How many square miles does Lake Michigan lack of being equal in area to Lake Huron?

6. The area of Lake Erie and Lake Ontario together is how many square miles less than the area of Lake Michigan?

7. What is the total area of the Great Lakes?

8. The area of Illinois, 56,665 square miles, is how much greater than the area of New York, 49,204 square miles?

9. How many more than 100,000 square miles is the area of both Illinois and New York?

10. A city has \$108,250; how much must it borrow to build a city hall to cost \$300,000?

11. The receipts and expenses of five pieces of property for one year were as follows: No. 1, receipts \$300, expenses \$73.50; No. 2, receipts \$450, expenses \$126.85; No. 3, receipts \$275, expenses \$49.47; No. 4, receipts \$360, expenses \$80.76; No. 5, receipts \$540, expenses \$187.80. Find (1) the total receipts; (2) the total expenses; (3) the excess of the receipts over the expenses; this is the net income.

12. The total area of Maine, 33,040 square miles, New Hampshire, 9341 square miles, Vermont, 9564 square miles, Massachusetts, 8266 square miles, Rhode Island, 1248 square miles, and Connecticut, 4965 square miles, is how much less than the area of California, 158,297 square miles?

MULTIPLICATION

Oral

Multiplication is the process of combining several equal numbers into one number.

What is the sign of multiplication? How is it read?

0
4
8
2
6
5
1
9
7
3

18 is the ——. What does it show?

4 is the ——. What does it show?

$\overline{72}$ is the ——. What does it show?

What is the product of:

(1) 7 times 6? (2) 7 times 6 men? (3) 7 times \$6?

The product always takes its name from the multiplicand.

What does the multiplier always show?

What kind of a number must the multiplier always be?

Multiply each of the numbers in the diagram by 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12.

Multiply by 20; 30; 40; 50; 60; 70; 80; 90.

Multiply by 10:

10 60 20 70 50 30 80 40 90

Multiply by 20; 40; 60; 80; 30; 50; 70; 90.

Multiply the numbers in the drill table on page 5 by 2; 3; 4; 5; 6; 7; 8; 9. Multiply in this way: 8 times 74 = 8 times 70, + 8 times 4. Think 560, 32, 592.

WRITTEN EXERCISES

1. Multiply 56 by 18.

56 Work in this multiplication may be tested in
18 three ways:

$\overline{448}$ (1) By multiplying 18 by 56. 56 times 18
56 = 1008.

$\overline{1008}$ Since 1008 is the product of the two factors 18 and 56, 1008 divided by either factor will give the other factor.

(2) By dividing 1008 by 18. $1008 \div 18 = 56$.

(3) By dividing 1008 by 56. $1008 \div 56 = 18$.

Find products, and test :

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>
2.	29	67	39	68	78	88	47
	<u>58</u>	<u>84</u>	<u>17</u>	<u>42</u>	<u>97</u>	<u>66</u>	<u>35</u>
3.	347	428	562	497	863	892	439
	<u>247</u>	<u>432</u>	<u>368</u>	<u>263</u>	<u>892</u>	<u>157</u>	<u>284</u>
4.	\$0.47	\$0.96	\$0.18	\$0.35	\$0.27	\$0.87	\$0.07
	<u>94</u>	<u>137</u>	<u>208</u>	<u>118</u>	<u>267</u>	<u>654</u>	<u>905</u>
5.	\$82.94	\$56.78	\$90.72	\$34.56	\$78.90	\$76.08	\$39.75
	<u>408</u>	<u>549</u>	<u>675</u>	<u>246</u>	<u>468</u>	<u>795</u>	<u>658</u>

$$3 \times 4 \times 5 = ? \quad 4 \times 5 \times 3 = ? \quad 5 \times 3 \times 4 = ? \quad 5 \times 4 \times 3 = ?$$

Does it make any difference in what order numbers are multiplied together?

Find the product, selecting multipliers to make your work as easy as possible :

- | | | |
|-----------------------------|------------------------------|-----------------------|
| 6. $50 \times 27 \times 4$ | 7. $45 \times 9 \times 2$ | 8. 1375×806 |
| 9. $28 \times 25 \times 2$ | 10. $4 \times 87 \times 15$ | 11. 6307×534 |
| 12. $57 \times 15 \times 4$ | 13. $65 \times 20 \times 5$ | 14. 4386×402 |
| 15. $96 \times 8 \times 5$ | 16. $150 \times 37 \times 2$ | 17. 408×8275 |
| 18. $72 \times 75 \times 2$ | 19. $28 \times 25 \times 4$ | 20. 3258×407 |

21. Find the product of 758 and 65,942.

22. Multiply 78,659 by 4037.

23. Make a table of the results and memorize :

$11 \times 11 =$ —	$16 \times 16 =$ —	$21 \times 21 =$ —
$12 \times 12 =$ —	$17 \times 17 =$ —	$22 \times 22 =$ —
$13 \times 13 =$ —	$18 \times 18 =$ —	$23 \times 23 =$ —
$14 \times 14 =$ —	$19 \times 19 =$ —	$24 \times 24 =$ —
$15 \times 15 =$ —	$20 \times 20 =$ —	$25 \times 25 =$ —

Name the two equal factors of:

24.	4	9	16	25	36	49	64	81
25.	100	400	121	361	441	144	324	484
26.	225	625	196	256	576	169	289	529

NOTE. Drill should be given on exercises 23, 24, 25, and 26, until pupils can give results instantly.

PROBLEMS

Written

1. How much will 48 tons of hay cost at \$23 a ton?
2. How many gallons of oil in 48 barrels of 42 gallons each?
3. How many yards of cloth in 35 cases if each case contains 72 pieces of 28 yards each?
4. How much must be paid for 68 sheep at \$5 each, and 2 cows at \$65 each?
5. Mr. Chase leases a house for 4 years at \$45 a month. What is the rent for the entire time?
6. It took 27 days for 14 men, working 8 hours a day, to lay a water pipe. This was how many hours' labor?
7. In gathering his crops, Mr. Fitch hires 4 men at \$1.85 a day and 2 boys at \$0.75 a day. How much does he pay for labor in 4 weeks?
8. An acre of land contains 43,560 square feet. How much is it worth at 7 cents a square foot?
9. Rocky Ford melons are shipped from Colorado in crates of 45 melons each, 300 crates to a car. How many melons in 8 carloads?

CASH ACCOUNTS

Alfred kept a cash account; that is, an account of money received and paid out. At the top of the left-hand page of his cash book he wrote Receipts. On this page he put down how much he had on hand and how much he received. At the top of the right-hand page he wrote Expenses. On this page he put down how much he paid out.

This was his account for one week :

1911				RECEIPTS		1911				EXPENSES	
June	1	On hand	1	28	June	2	Ball game		25		
	3	Cutting lawn		60			Blank book		10		
		Aunt Sarah		50		3	Pencils		08		
		Allowance		25		5	Car fares		15		
						6	Rabbit		25		
							Fountain pen	1	15		
							Balance		65		
				2	63				2	63	

1. How much money had he during the week?
2. How much did he spend?
3. What was the difference between his receipts and his expenses?
4. Write his account for the next week, in which he cut two lawns, one for 50 cents, the other for 60 cents; sold his rabbit for 40 cents; received 20 cents for running errands, and his allowance of 25 cents; spent 50 cents at the circus, 15 cents for peanuts, 75 cents for a trapeze, and 67 cents for a dog collar. Use any dates between

June 8 and 14 that you wish. What item must be put down first on the left-hand page?

5. Another boy had 43 cents on hand at the beginning of a week. He earned \$1.85 selling papers, 40 cents running errands for the grocer, and 75 cents taking care of a furnace. He spent 65 cents for an arithmetic, 5 cents for paper, 3 cents for a pencil, and 25 cents for a cap. Write his cash account.

6. Keep your cash account for one week and show it to your parents.

NOTE. Imaginary cash accounts should be made from data furnished by pupils.

PARTS OF 100

Oral

1. What part of 100 is 50? 5? 25? 75? 20? 40? 60? 80? 10? 30? 70? 90?

2. Learn:

$33\frac{1}{3}$ is $\frac{1}{3}$ of 100

$66\frac{2}{3}$ is $\frac{2}{3}$ of 100

$16\frac{2}{3}$ is $\frac{1}{6}$ of 100

$83\frac{1}{3}$ is $\frac{5}{6}$ of 100

$12\frac{1}{2}$ is $\frac{1}{8}$ of 100

$87\frac{1}{2}$ is $\frac{7}{8}$ of 100

$62\frac{1}{2}$ is $\frac{5}{8}$ of 100

$37\frac{1}{2}$ is $\frac{3}{8}$ of 100

3. What part of a dollar is 90¢? 87½¢? 83⅓¢? 80¢? 75¢? 70¢? 66⅔¢? 62½¢? 60¢? 50¢? 40¢? 37½¢? 33⅓¢? 30¢? 25¢? 20¢? 16⅔¢? 12½¢? 10¢? 5¢? 2¢? 1¢?

SHORT METHODS IN MULTIPLICATION

Oral

1. What is the cost of 8 neckties at 50¢ each?

SOLUTION. At \$1 each, they would cost \$8. At 50¢ each, they will cost $\frac{1}{2}$ of \$8, or \$4.

Find the cost of :

2. 12 caps @ 25¢
3. 28 yards of cloth @ 75¢
4. 40 plates @ $37\frac{1}{2}$ ¢
5. 72 bushels of grain @ $87\frac{1}{2}$ ¢
6. 36 brushes @ $33\frac{1}{3}$ ¢
7. 48 pairs of slippers @ $62\frac{1}{2}$ ¢
8. 32 books @ $62\frac{1}{2}$ ¢
9. 18 bushels of apples @ $66\frac{2}{3}$ ¢
10. 30 pans @ $16\frac{2}{3}$ ¢
11. 17 pairs of gloves @ 50¢
12. At 75 cents a bag, what will 16 bags of flour cost?
13. Mrs. Dodge bought 16 yards of dress goods at $62\frac{1}{2}$ ¢ a yard. How much did she pay?
14. How much must be paid for 100 skeins of yarn at $12\frac{1}{2}$ ¢ each?
15. At $87\frac{1}{2}$ ¢ each, how much will 2 dozen pieces of sheet music cost?

Make and solve problems based on the following :

NUMBER OF ARTICLES	PRICE OF EACH	NUMBER OF ARTICLES	PRICE OF EACH
16. 24	50¢	17. 60	\$0.25
18. 32	75¢	19. 64	\$0.37 $\frac{1}{2}$
20. 40	$87\frac{1}{2}$ ¢	21. 48	\$0.66 $\frac{2}{3}$
22. 54	$16\frac{2}{3}$ ¢	23. 40	\$0.62 $\frac{1}{2}$
24. 27	$33\frac{1}{3}$ ¢	25. 56	\$0.12 $\frac{1}{2}$
26. 15	50¢	27. 14	\$0.25
28. 18	$83\frac{1}{3}$ ¢	29. 12	\$0.12 $\frac{1}{2}$

30. Multiply 36 by 50.

100 times 36 = 3600. 50 is $\frac{1}{2}$ of 100. Then 50 times 36 is $\frac{1}{2}$ of 100 times 36, or 1800. Think 36, 3600, 1800.

Multiply by 50 ; 25 :

31. 48 32 64 52 40 80 60 28 72 84
32. 24 20 36 76 68 56 44 88 90 60

Multiply by $12\frac{1}{2}$; 25; 50:

33. 8 16 32 40 56 64 80 48 72 96

Multiply by $33\frac{1}{3}$; $16\frac{2}{3}$; 50:

34. 6 12 24 18 48 30 72 36 42 60

DIVISION

Oral

Division is the process of finding how many times one number is contained in another number, or of finding one of the equal parts of a number.

What is the sign of division? What does it show?

What is the dividend? Divisor? Quotient?

When 1 hat costs \$3, how is the number that can be bought for \$24 found?

When 8 hats cost \$24, how is the cost of 1 found?

How is work in division tested:

(1) When there is no remainder? Illustrate with 54 divided by 9.

(2) When there is a remainder? Illustrate with 54 divided by 5.

Divide the numbers in the drill table on page 5 by 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12.

DRILL IN DIVISION

Written

Divide 1645 by 47 and test your work.

35 This division may be tested in two ways:

$47 \overline{)1645}$ (1) By finding the product of 47 and 35.

The result equals the dividend.

(2) By dividing 1645 by 35. The result is the divisor.

What is the dividend when the quotient is 37 and the divisor 79?

I. Divide (short division) each dividend in the examples below by 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12.

II. Solve:

	<i>A</i>	<i>B</i>	<i>C</i>
1.	$735 + 32$	$502 + 28$	$873 + 123$
2.	$936 + 27$	$753 + 45$	$927 + 204$
3.	$438 + 19$	$820 + 33$	$624 + 157$
4.	$675 + 28$	$908 + 26$	$738 + 236$
5.	$876 + 37$	$627 + 35$	$875 + 352$
6.	$8647 + 56$	$8760 + 59$	$9801 + 262$
7.	$3579 + 42$	$5642 + 97$	$5624 + 371$
8.	$8246 + 73$	$2746 + 78$	$9000 + 268$
9.	$1357 + 45$	$8400 + 36$	$5628 + 537$
10.	$9246 + 56$	$5207 + 49$	$4835 + 942$
11.	$8157 + 97$	$7000 + 73$	$2764 + 127$
12.	$4321 + 39$	$7465 + 58$	$6408 + 809$
13.	$8901 + 64$	$8400 + 86$	$3769 + 543$
14.	$5730 + 82$	$3498 + 39$	$6437 + 276$
15.	$5087 + 75$	$4356 + 45$	$7500 + 324$
16.	$84,327 + 64$	$72,468 + 352$	$187,604 + 427$
17.	$73,820 + 87$	$93,807 + 654$	$537,416 + 609$
18.	$17,600 + 96$	$76,491 + 326$	$806,320 + 347$
19.	$30,874 + 52$	$47,000 + 742$	$943,076 + 465$
20.	$56,792 + 48$	$86,308 + 564$	$706,321 + 857$

21. How many times is 309 contained in 13,596?

22. By what must 2576 be divided to get a quotient of 46?

23. In dividing a number by 9, the quotient is 100 and the remainder 7. What is the number?

24. In dividing 1247 by a certain number, the quotient is 37 and the remainder 26. What is the divisor?

25. What is the dividend when divisor and quotient are both 48?

26. What is one of the 27 equal parts of 1161?

27. What is $\frac{1}{8}$ of 4872?

28. Six hundred eighty-four is made up of three factors. Two of the factors are 9 and 19. What is the third?

SHORT METHODS IN DIVISION

Oral

1. How many times is 50 cents contained in 1 dollar?
2. 25 cents is contained how many times in 1 dollar?
In 50 cents? In 75 cents?

3. $12\frac{1}{2}$ cents is contained how many times in 1 dollar?
In 50 cents? In 25 cents? In 75 cents?

4. $33\frac{1}{3}$ cents is contained how many times in 1 dollar?
5. How many times is $16\frac{2}{3}$ cents contained in 1 dollar?
In 50 cents?

6. Divide \$2 by $12\frac{1}{2}$ cents.
 $12\frac{1}{2}$ cents is contained — times in \$1; in \$2 it is contained — times.

Using a short method, divide:

- | | | |
|------------------------------|---------------------------------|----------------------------------|
| 7. \$8 by 25¢ | 8. \$1.50 by 25¢ | 9. \$2.75 by 25¢ |
| 10. \$6 by 50¢ | 11. \$2.50 by 50¢ | 12. \$3.50 by 50¢ |
| 13. \$4 by $16\frac{2}{3}$ ¢ | 14. \$2.50 by $16\frac{2}{3}$ ¢ | 15. \$4.50 by $16\frac{2}{3}$ ¢ |
| 16. \$5 by $33\frac{1}{3}$ ¢ | 17. \$7.00 by $33\frac{1}{3}$ ¢ | 18. \$10.00 by $33\frac{1}{3}$ ¢ |
| 19. \$3 by $12\frac{1}{2}$ ¢ | 20. \$0.75 by $12\frac{1}{2}$ ¢ | 21. \$1.25 by $12\frac{1}{2}$ ¢ |

PROBLEMS

Oral

1. I have \$12. How many knives can I buy at 50¢ each? $33\frac{1}{2}$ ¢? $12\frac{1}{2}$ ¢? 25¢? $16\frac{2}{3}$ ¢?

2. How many handkerchiefs at 25 cents each can be bought for \$2? \$3.50? \$0.75? $\$1\frac{1}{4}$? \$6?

3. How many yards of crash at $12\frac{1}{2}$ cents a yard does a bill of \$3 represent? A bill of \$1.25? \$5? \$3.75? \$2.50?

4. When eggs are 25¢ a dozen, a case costs \$7.50. How many dozen in a case?

5. A shipment of paper costs \$12. The rate is $12\frac{1}{2}$ cents a pound. What is the weight?

6. At $16\frac{2}{3}$ cents an hour, a boy working on a farm earned \$7. How many hours did he work?

7. At $33\frac{1}{3}$ cents an hour, his father earned \$15. How many hours did he work?

DIVISORS AND DIVIDENDS ENDING IN 0 *Written*

$$240 \div 30$$

$$\begin{array}{r} 30 \overline{)240} \\ 8 \end{array}$$

$$2400 \div 300$$

$$\begin{array}{r} 300 \overline{)2400} \\ 8 \end{array}$$

$$98,000 \div 2000$$

$$\begin{array}{r} 2000 \overline{)98000} \\ 49 \end{array}$$

Solve:

1. $980 \div 70$

2. $1360 \div 80$

3. $5100 \div 300$

4. $1760 \div 80$

5. $1170 \div 90$

6. $7600 \div 400$

7. $700 \div 50$

8. $1020 \div 60$

9. $8400 \div 700$

10. $1280 \div 80$

11. $850 \div 50$

12. $7800 \div 600$

13. $1440 \div 60$

14. $2700 \div 90$

15. $108,900 \div 900$

16. How many tons of hay in a car of 38,000 pounds?

Find the number of tons of fertilizer in :

- | | | |
|----------------|----------------|-----------------|
| 17. 18,000 lb. | 18. 29,300 lb. | 19. 225,000 lb. |
| 20. 48,000 lb. | 21. 37,400 lb. | 22. 637,000 lb. |
| 23. 75,000 lb. | 24. 19,500 lb. | 25. 861,000 lb. |

PROBLEMS

Written

1. At \$15 a ton, a bill for hay was \$405. How many tons were bought?

2. Mr. Flagg sold 19 acres of land for \$1482. How much did he receive an acre?

3. Twenty-eight bushels of oats were bought for \$15.68. What was the rate per bushel?

4. At \$0.85 each, how many books can be bought for \$9.45?

$$\begin{array}{r} .35 \overline{)9.45} \end{array}$$

$$\begin{array}{r} 27 \\ 35 \overline{)945} \end{array}$$

When the divisor contains cents, change both dividend and divisor to cents.

5. A fruit dealer paid \$77 for oranges at \$2.75 a box. How many boxes did he buy?

6. A florist purchased lily bulbs at \$0.25 each. His bill was \$12.75. How many did he buy?

7. How many sleds at \$1.35 each does a bill of \$64.80 represent?

8. A sale of shovels at 85 cents each yielded \$44.20. How many were sold?

9. A hardware dealer's bill for saws was \$104.40. If each saw cost 87 cents, how many were bought?

10. How many peach trees at \$2.25 each can be bought for \$29.25?

11. A man asked \$1.75 a day for his work on a farm. He received \$47.25. How many days did he work?

12. At \$7.25 per cord, how many cords of wood can be bought for \$195.75?

RATIO

Oral

1. What is the relation of 24 to 6? $24 \div 6$, or 4.

2. What is the relation of 6 to 24? $6 \div 24$, or $\frac{1}{4}$.

The relation of one number to another is their ratio.

Ratio is indicated by the sign : placed between the two numbers or quantities, and is equivalent to the sign \div .

Find the ratios:

3. 10 : 2 4. 15 : 3 5. 20 : 5 6. 32 : 8

7. 4 : 12 8. 7 : 42 9. 9 : 63 10. 8 : 48

11. 2 : 3 12. 3 : 4 13. 5 : 8 14. 6 : 9

15. 12 : 20 16. 10 : 15 17. 15 : 6 18. 20 : 16

19. 9 books : 63 books 20. 56 days : 7 days

21. 8 dollars : 72 dollars 22. 40 bushels : 5 bushels

23. 27 days : 30 days 24. 24 pencils : 60 pencils

25. 32 trees : 80 trees 26. 27 cents : 45 cents

27. 5 days to a week. (Since only things of the same kind can be compared, change the week to days.)

28. 3 days : 2 weeks 29. 3 quarts : 1 gallon

30. 2 bushels : 1 peck 31. 27 inches : 1 yard

32. 2 years : 1 month 33. 6 feet : 8 inches

34. $1\frac{1}{2}$ feet : 1 yard 35. 30 minutes : $2\frac{1}{2}$ hours

36. James buys corncakes at the rate of 3 for 5 cents. How much does he pay for a box of 60?

37. Mrs. Arnold bought 12 quarts of berries for 75 cents. What would 4 quarts cost at the same rate?

38. If a farmer raises 7 tons of hay on 5 acres of land, what ought he to raise on 35 acres?

39. If 18 bushes produce \$12 worth of roses, how many bushes will produce \$72 worth?

RECEIPTS

\$ 20.00	Chicago, Mar. 1, 1910.
Received from Arthur Y. Waite	
Twenty $\frac{x}{100}$ Dollars	
for rent of house at No. 24 Mason St.	
from Mar. 1, 1910, to April 1, 1910.	
Charles F. Young	

Who paid money? How much? For what? To whom? When? What shows that money has been paid?

This paper is a receipt.

Study the receipt until you can write a similar one.

Why should receipts always be preserved?

\$	19
Received from	
$\frac{\quad}{100}$ Dollars	
for	

1. This shows a blank receipt such as can be bought at any stationery store. Copy the form and fill in the blanks as you would in giving a receipt to one of your school-mates who hires your cart for 50 cents.

2. Write a receipt for \$150 received for the sale of a gray horse.

3. Suppose that you own and rent a house for \$25 a month. Write a receipt for a month's rent.

4. You sold your bicycle for \$12.50. Write the receipt.

5. Write a receipt for 3 months' work on a farm at \$20 per month.

BILLS

ST. LOUIS, July 17, 1910.

Mr. JAMES K. BRYANT

Bought of STEVENS & WRIGHT

July 1	2½ lb. Steak	@	.28				
3	1¼ lb. Ham		.25				
	4 Cucumbers		.05				
6	2 boxes Berries		.17				
	½ peck Peas		.50				
	Received payment,						
	STEVENS & WRIGHT.						
	By Harper.						

When were the purchases made? By whom? From whom? Cost of each item? Amount of the bill?

What shows that the bill has been paid?

Was payment made directly to the owners of the store or to one of their clerks?

When a bill contains the words "Received payment" followed by the signature of the seller or his agent, it is a *receipt*.

There are two parties in a sale — the debtor and the creditor.

The debtor is the one who buys ; he owes something.

The creditor is the one who sells ; he is one to whom something is owed.

Who is the debtor in the above bill? Creditor?

1. Complete this bill :

CLEVELAND, Jan. 16, 1911.

Mr. GARFIELD S. PARKER

Bought of THE STRONG MANUFACTURING CO.

200 Hammers	@	.18				
50 3" Chisels		.42				
50 2" Chisels		.32				
50 1½" Chisels		.28				

Notice that when the articles are all bought at one time, the date of the bill is the date of purchase.

2. The equipment for the sewing class was: 4 dozen pairs of scissors at 20 cents each, 4 dozen measures at 2 cents apiece, 6 5-cent papers of needles, 6 papers of pins at 8 cents each, 100 spools of thread at 3 cents each, and 2 dollars' worth of cloth. Make out the bill. Buyer, the city in which you live. Seller, yourself.

3. Alice made a dress, using these materials: 1 pattern @ 15 cents, 8 yards of gingham @ 15 cents, 1 spool of

thread @ 5 cents, $1\frac{1}{2}$ dozen buttons @ 10 cents, and 5 yards of lace @ 12 cents. Make out the bill.

4. The boys of a baseball nine bought 4 bats @ \$0.50, 2 balls @ \$0.75, a catcher's mask for \$2.75, and 4 mitts @ \$0.80. Make out the bill to the treasurer of the club. They shared the cost equally. How much did each pay?

5. Imagine that you are going on a journey and buy collars, shoes, and umbrella. Make out the bill.

6. Make out the bill for three things you buy for your mother from the grocer.

7. Make out Mr. C. K. Austin's milk bill for October, supposing that he takes 1 quart a day at 8 cents a quart, and during the month has $1\frac{1}{2}$ quarts of cream at 30 cents a quart.

8. Ten boys and girls are going on a picnic, and one of them is selected to buy things they need. Make out the bill for four things you think he will buy.

9. Make out other bills for goods purchased at different stores, using the prices given in the daily paper.

DICTATION EXERCISES

1. $12 \times 9, + 2, + 11, \times 4, - 8, + 8, \times 9, + 9, + 5, + 10.$
2. $54 \div 6, + 3, \times 5, + 2, - 2, + 7, + 12, \times 3, - 6, + 7.$
3. $72 \div 6, - 3, \times 6, + 2, + 7, + 12, - 5, + 3, + 8, \times 2.$
4. $16 \times 4, + 2, + 3, + 8, + 5, \times 7, - 6, + 9, + 11, \times 3.$
5. $80 - 5, + 15, + 9, \times 2, + 4, + 8, + 5, \times 7, + 6, + 9.$
6. $144 \div 12, + 6, \times 5, + 9, + 11, + 3, + 5, \times 9, - 12, + 8.$
7. $84 \div 7, + 8, \times 4, - 5, + 25, \times 8, - 3, + 7, + 16.$
8. $56 \div 8, \times 4, + 2, - 6, \times 9, + 3, + 5, - 8, \times 9, - 7.$
9. $7 \times 7, + 5, + 6, \times 3, + 8, + 5, + 2, \times 8, - 6, + 11.$

10. $9 \times 9, -6, +5, +20, -1, \times 8, +9, \times 2, +11, \times 5.$
11. $8 + 7, + 3, - 5, + 6, \times 9, + 2, + 8, \times 6, + 3, + 9.$
12. $64 + 8, + 7, \times 4, + 3, + 8, + 7, \times 9, - 20, \times 3, + 4, \times 0.$
13. $6 + 8, - 10, \times 9, + 3, + 12, - 6, + 2, + 5, - 4, + 17.$
14. $9 \times 5, + 3, + 6, + 7, + 9, \times 8, + 3, + 3, + 7, \times 0.$
15. $6 \times 3, + 7, + 5, \times 3, + 5, + 4, + 1\text{£}, + 6, + 7, \times 12.$

Similar examples should be dictated daily.

MISCELLANEOUS PROBLEMS

Written

1. Lake Ontario is 234 feet above sea level, Lake Erie is 330 feet higher than Lake Ontario, Lake Huron 10 feet higher than Lake Erie, Lake Michigan 4 feet higher than Lake Huron, and Lake Superior 22 feet higher than Lake Michigan. How many feet above sea level is Lake Superior?

A leaf from the time book of Mr. Blake, a contractor, showing the number of hours each employe worked each day for a week, and the pay of each per hour.

	M.	T.	W.	T.	F.	S.	TOTAL HOURS	PAY PER HOUR	AMOUNT DUE FOR WEEK'S WORK
C. E. Austin	8	8	7	4	6	8		\$.35	\$
A. P. Dudley	8	8	8	8	8	8		.30	
H. G. Preston	6	8	3	8	5	8		.40	
O. L. Jackson	8	8	4	6	5	7		.25	
T. M. Perry	3	4	8	5	7	8		.27	
Total \$									

2. Find (1) the total number of hours each man worked; (2) the wages of each for the week; and (3) total pay of all.

3. A plumber receives 80 cents an hour for a day's work of 8 hours, and double pay for overtime. How much does he earn in a week when he works 6 hours overtime?

4. What are the average daily earnings of a boy who receives \$0.88, \$0.25, \$1.15, \$0.75, \$0.50, and \$0.61 in one week?

5. One suit of clothes cost \$12.75 and another twice as much. What did both cost?

6. Two farm wagons cost \$50. One cost \$27.50. How much did the other cost?

7. What is the cost of 8 plows at \$6.75 each?

8. How many churns at \$6.75 each can be bought for \$108?

9. 18 watches cost \$135; what is the price of one?

10. What is the gain on a dozen cans of tomatoes bought at \$1.32 per dozen and sold at 15 cents apiece?

11. When 75 pounds of ham are bought for 24 cents a pound, for how much must the lot be sold to gain 4 cents a pound?

12. With money received by a will a man bought a house for \$3950 and 16 acres of land at \$125 an acre. What was the amount of the legacy?

13. Mr. Holt raised 288 bushels of rye on 24 acres of land. At the same yield per acre, how many bushels did he get the next year from a field of 8 acres?

14. A dealer in farm supplies paid \$675 for hay rakes at \$18.75 each. How many did he buy?

15. At another time he bought 28 potato diggers for \$567. How much apiece?

16. If he paid \$18.75 apiece for cotton planters and sold them at \$25 each, what was his gain on 36?

17. In one month he made \$180 by buying disc cultivators at \$22.50 and selling at \$30. How many did he sell?

18. At \$1.28 each, how much will 24 umbrellas cost?

19. What is the cost of 15 tons of coal at \$6.75 a ton, and 6 cords of wood at \$7.50 a cord?

SALES IN A DEPARTMENT STORE

	DRY GOODS		SHOES		GLOVES	
	Cash	Charge	Cash	Charge	Cash	Charge
Mon.	\$297.15		\$416.87		\$120.49	
Tu.	455.80	\$168.70	115.00	\$197.00	189.15	\$69.38
Wed.	264.39	237.63	237.08	378.18	205.45	112.27
Th.	317.83	308.07	345.42	198.14	117.13	37.49
Fri.	453.75	359.03	100.90	275.00	269.00	203.86
Sat.	689.29	576.24	346.80	109.73	200.78	158.08
		190.87		538.73		217.90

20. Find:

- (1) Total cash sales in each department for the week.
- (2) Total charge sales in each department for the week.
- (3) Total cash sales on each day of the week.
- (4) Total charge sales on each day of the week.
- (5) Total sales in each department for the week.
- (6) Total sales in all departments for the week.
- (7) Total sales in all departments for each day.
- (8) Total daily sales in all departments for the week.

21. A telephone rental is \$8.50 a month. What is the yearly rental?

22. A business man pays yearly \$36 for his office telephone, and \$27 for his house telephone. How much does he pay every month?

23. Boxwood 2-foot rules are bought at 8 cents and sold for 10 cents. How many must be sold to gain one dollar?

24. At \$1.62 a yard, a piece of silk cost \$84.24. How many yards in the piece?

FACTORS

Oral

1. Name five numbers between 10 and 100 and tell their factors.

2. What are the factors of a number?

A number that can be separated into factors is a composite number.

3. Name the composite numbers below 26; between 26 and 47; 47 and 73; 73 and 100.

A number that cannot be separated into factors is a prime number.

4. Name the prime numbers below 25; between 25 and 50; between 50 and 75; between 75 and 100.

A prime number used as a factor is a prime factor.

5. Name the prime factors of 60.

We may think of 60 as 6×10 . The prime factors of 6 are 2 and 3; the prime factors of 10 are 2 and 5; therefore, the prime factors of 60 are 2, 2, 3, and 5.

6. Name the prime factors of:

28 36 40 48 54 56 72 80 81 144

NOTE. Going rapidly around the class, let the pupils recite as follows: 1 is a prime number; 2 is a prime number; 3 is a prime number;

4 is a composite number, its prime factors are 2 and 2; 5 is a prime number; 6 is a composite number, its prime factors are 2 and 3; and so on to 100.

When several equal factors occur in the answer, a small figure, called an *exponent*, is written at the right and a little above the factor to show how many times the factor is used. Thus, 2^3 means that 2 is used as a factor three times. $2 \times 2 \times 2 = 8$.

The factors of 72—2, 2, 2, 3, 3—are written $2^3 \times 3^2$.

7. What number does 5^2 represent? 2^5 ?
8. 2×5^2 are the prime factors of what number?
9. Of what number are $2^2 \times 3^2$ the prime factors?
10. The prime factors of a number are $2^2 \times 3 \times 5^2$. What is the number?

Written

11. What are the prime factors of 168?

$$\begin{array}{r} 2 \overline{)168} \\ 2 \overline{)84} \\ 2 \overline{)42} \\ 3 \overline{)21} \\ \quad 7 \end{array}$$

To find the prime factors of a number not readily factored by inspection, we divide the number by one of its prime factors; then divide the resulting quotient by one of its prime factors, and continue the division until the resulting quotient is prime. The several divisors and the

Ans. $2^3 \times 3 \times 7$. last quotient are the prime factors.

Find the prime factors of:

- | | | | | |
|---------|---------|---------|---------|---------|
| 12. 125 | 13. 126 | 14. 185 | 15. 136 | 16. 165 |
| 17. 245 | 18. 252 | 19. 288 | 20. 296 | 21. 268 |

GREATEST COMMON DIVISOR

Oral

1. What is the greatest number that will exactly divide 12 and 18?

The greatest number that will exactly divide two or more numbers is their greatest common divisor (g. c. d.).

Name the greatest common divisor of :

- | | | | |
|----------------|----------------|----------------|-----------|
| 2. 16, 24 | 3. 18, 27 | 4. 32, 40 | 5. 28, 42 |
| 6. 42, 56 | 7. 36, 54 | 8. 35, 56 | 9. 21, 32 |
| 10. 6, 8, 12 | 11. 9, 12, 15 | 12. 12, 15, 18 | |
| 13. 12, 20, 30 | 14. 6, 15, 27 | 15. 10, 25, 30 | |
| 16. 9, 27, 45 | 17. 12, 15, 24 | 18. 21, 28, 35 | |
| 19. 18, 24, 30 | 20. 32, 48, 60 | 21. 36, 54, 72 | |

Written

22. What is the greatest common divisor of 48, 84, and 90?

$$\begin{array}{r|rrr}
 2 & 48 & 84 & 90 \\
 3 & 24 & 42 & 45 \\
 \hline
 & 8 & 14 & 15
 \end{array}$$

$2 \times 3 = 6$, the g. c. d.

When the g. c. d. is not readily found by inspection, use this method. Arrange the numbers in a row and successively divide them by any number that will exactly divide all of them. Repeat the process with the resulting quotients. Continue

the division until there is no number that will exactly divide all of the quotients. The product of the several divisors is the greatest common divisor. 2 and 3 are common divisors of all the numbers. Their product, 6, is the greatest common divisor of the numbers.

Find the greatest common divisor of :

- | | | |
|----------------|-----------------|----------------|
| 23. 42, 63, 84 | 24. 27, 63, 81 | 25. 32, 64, 96 |
| 26. 42, 70, 98 | 27. 54, 72, 90 | 28. 32, 56, 84 |
| 29. 35, 42, 91 | 30. 84, 96, 144 | 31. 36, 54, 72 |

LEAST COMMON MULTIPLE

Oral

A multiple of a number is a number obtained by using that number as a factor. Thus, 2, 4, 6, 8, 10, etc., are multiples of 2.

1. Name some multiples of 3.
2. Name some multiples of both 2 and 3.

Since 6, 12, 18 are multiples of both 2 and 3, they are common multiples of 2 and 3.

A number that is a multiple of two or more numbers is a common multiple of the numbers.

The least multiple common to two or more numbers is their least common multiple (l. c. m.).

Name the least common multiple of:

3. 7 and 8 4. 4 and 10 5. 6 and 9 6. 8 and 6
7. 8 and 12 8. 9 and 12 9. 10 and 15 10. 12 and 15

Written

11. Find the least common multiple of 8, 10, and 12.

$$\begin{array}{r|rrr} 2 & 8 & 10 & 12 \\ \hline 2 & 4 & 5 & 6 \\ \hline & 2 & 5 & 3 \end{array}$$

$$2 \times 2 \times 2 \times 5 \times 3 = 120$$

When the least common multiple is not readily seen, use this method.

Divide the numbers by any factor common to two or more of them. Continue the division of the resulting quotients until no two of them have a common factor. The divisors and the remaining quotients are the factors of the least common multiple.

Find, in the easiest way possible, the least common multiple of:

12. 12, 28 13. 18, 24 14. 16, 20 15. 20, 35
16. 8, 10, 12 17. 12, 16, 20⁺ 18. 15, 20, 40⁺ 19. 16, 24, 30
⁺20. 9, 12, 15⁺ 21. 12, 15, 18[×] 22. 16, 20, 24[×] 23. 15, 18, 24

USE OF SIGNS

Operations in arithmetic are indicated by signs. The signs most commonly used are +, -, ×, ÷.

When several operations are indicated in the same expression, operations indicated by × and ÷ are performed

before operations indicated by $+$ and $-$. Thus, in $8 + 6 \times 2$, first multiply 6 by 2, and then add their product to 8. $8 + 6 \times 2 = 8 + 12 = 20$.

Solve:

1. $24 - 8 \times 2$
2. $24 + 8 + 2$
3. $20 - 8 + 2$
4. $27 + 3 + 3$
5. $12 \times 8 + 4$
6. $12 + 8 \times 4$
7. $9 + 3 \times 2$
8. $36 + 4 + 8$
9. $36 - 8 + 4$
10. $16 + 4 \times 8$
11. $16 + 2 + 2$
12. $16 - 2 \times 2$
13. $2 + 3 + 4 \times 5$
14. $2 \times 3 + 4 \times 5$
15. $2 \times 3 \times 4 + 5$
16. $24 + 3 + 9 + 3$
17. $18 - 3 + 3 \times 2$
18. $7 \times 2 + 21 + 3$
19. $24 + 3 \times 9 - 3$
20. $18 - 9 + 3 \times 2$
21. $18 + 9 + 3 - 2$
22. $18 + 9 + 3 \times 2$
23. Which is larger, $10 + 10 + 10$ or $10 - 10 + 10$?
24. Show that $42 + 6 + 7$ is equal to $42 - 7 \times 4$.
25. What is the value of $4 \times 5 + 6 \times 7 - 8 + 4$?
26. What is the sum of $66 + 6 + 5$ and $66 - 5 \times 10$?
27. What is the product of $8 + 56 + 8$ and $56 - 12 \times 4$?
28. How many times is $32 + 8 + 5$ contained in $32 + 8 \times 5$?

CANCELLATION

1. Divide $7 \times 8 \times 12$ by 4×6 .

$$\frac{\overset{2}{7} \times \overset{2}{8} \times \overset{2}{12}}{\cancel{4} \times \cancel{6}} = 28$$

2. What factors are common to both dividend and divisor?
3. Does striking out or canceling equal factors from both dividend and divisor affect the quotient?

Divide :

4. $12 \times 10 \times 9$ by 4×5
5. $24 \times 15 \times 6$ by $8 \times 5 \times 3$
6. $14 \times 20 \times 6$ by $7 \times 10 \times 2$
7. $18 \times 60 \times 15$ by $9 \times 5 \times 20$
8. $15 \times 44 \times 18$ by $22 \times 5 \times 9$
9. $36 \times 32 \times 16$ by $24 \times 3 \times 8$
10. $64 \times 35 \times 42 \times 40$ by $8 \times 56 \times 12 \times 10$
11. $72 \times 81 \times 45 \times 28$ by $90 \times 144 \times 63$
12. $\frac{100 \times 75 \times 50 \times 17}{150 \times 25 \times 4}$
13. $\frac{48 \times 36 \times 24}{1728}$
14. $\frac{21120}{4752}$

DRILL EXERCISE IN RAPID ADDITION AND SUBTRACTION

10	8	7	13	5	4	21	11	7	9
5									12
12									7
8									10
6									8
15									31
10									7
7									10
6									6
9	4	12	7	20	15	8	6	11	8

Beginning with any number in the margin and going in either direction, rapidly add the numbers until 100 or any given number is reached.

Beginning with 100 or any given number, rapidly subtract the successive numbers.

FRACTIONS

A unit is a single thing; as 1 apple.

A fraction is one or more of the equal parts of a unit; as $\frac{3}{4}$ of an apple.

$\frac{3}{4}$ of an apple means that an apple has been divided into 4 equal parts and 3 of these parts taken.

In a fraction :

(1) The figure below the line is the denominator; it denominates or names the number of equal parts into which the unit is divided; it is the namer.

(2) The figure above the line is the numerator; it numerates or tells the number of parts taken; it is the numberer.

The numerator and denominator are the terms of the fraction.

1. In the fraction $\frac{6}{5}$:

(1) What is the 6 called? What does it show?

(2) What is the 5 called? What does it show?

(3) What does the fraction $\frac{6}{5}$ show?

2. Read aloud and tell what the terms of each fraction show :

$\frac{7}{9}$
 $\frac{7}{9}$

$\frac{5}{12}$
 $\frac{5}{12}$ of an acre

$\frac{2}{7}$
 $\frac{2}{7}$ bu.

$\frac{3}{8}$
 $\frac{3}{8}$ gal.

$\frac{12}{20}$
 $\frac{12}{20}$ yd.

CHANGING THE FORM OF FRACTIONS

Oral

1. Which do you prefer, $\frac{3}{4}$ of a dollar or $\frac{1}{2}$ of a dollar? $\frac{6}{8}$ of a pound of candy or $\frac{3}{4}$ of a pound of candy?

2. Are $\frac{2}{4}$ and $\frac{1}{2}$ alike in form? Are they alike in value?

3. Are $\frac{3}{8}$ and $\frac{3}{4}$ alike in value? In form?
4. How many equal parts in $\frac{3}{4}$ of a dollar?
5. How many equal parts in $\frac{3}{8}$ of a dollar?
6. What is the size of the equal parts in $\frac{3}{4}$ of a dollar?
7. What is the size of the equal parts in $\frac{3}{8}$ of a dollar?
8. Are 8ths of a dollar larger or smaller than 4ths of a dollar?

In $\frac{3}{8}$ of a dollar there are twice as many equal parts as in $\frac{3}{4}$ of a dollar, but the equal parts are only one half as large.

In $\frac{3}{4}$ of a dollar there are one half as many equal parts as in $\frac{3}{8}$ of a dollar, but the equal parts are twice as large.

The form of a fraction may be changed without changing its value:

(1) By multiplying both terms of the fraction by the same number.

$$\text{Thus,} \quad \frac{3}{4} \times \frac{2}{2} = \frac{6}{8}$$

This is changing to higher terms.

(2) By dividing both terms of the fraction by the same number.

$$\text{Thus,} \quad \frac{6}{8} \div \frac{2}{2} = \frac{3}{4}$$

This is changing to lower terms.

CHANGING TO HIGHER TERMS

1. Change $\frac{3}{8}$ to twenty-fourths.

$$\frac{3}{8} \times \frac{3}{3} = \frac{9}{24}$$

To get 24 as the denominator, we multiply the denominator by 3. In order not to change the value of the fraction, we also multiply the numerator by 3.

To change a fraction to higher terms, multiply both terms of the fraction by that number which will give the required denominator.

2. Change to 12ths: $\frac{1}{2}$ $\frac{2}{3}$ $\frac{3}{4}$ $\frac{5}{6}$
3. Change to 18ths: $\frac{2}{3}$ $\frac{3}{4}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{5}{9}$ $\frac{5}{6}$
4. Change to 24ths: $\frac{1}{2}$ $\frac{2}{3}$ $\frac{3}{4}$ $\frac{5}{6}$ $\frac{5}{8}$ $\frac{7}{12}$
5. Change to 32ds: $\frac{1}{2}$ $\frac{3}{4}$ $\frac{5}{8}$ $\frac{3}{16}$
6. Change to 36ths: $\frac{1}{18}$ $\frac{2}{9}$ $\frac{5}{12}$ $\frac{5}{6}$ $\frac{3}{4}$ $\frac{2}{3}$ $\frac{1}{2}$
7. Change to 40ths: $\frac{2}{20}$ $\frac{7}{10}$ $\frac{1}{5}$ $\frac{5}{8}$ $\frac{1}{2}$ $\frac{3}{4}$

CHANGING TO LOWEST TERMS

Oral

1. Change $\frac{24}{54}$ to its lowest terms.

$$\frac{24 \div 6}{54 \div 6} = \frac{12 \div 3}{27 \div 3} = \frac{4}{9}$$

Dividing both terms of $\frac{24}{54}$ by 6, we get $\frac{4}{9}$; dividing both terms of $\frac{12}{27}$ by 3, we get $\frac{4}{9}$.

or

$$\frac{24 \div 6}{54 \div 6} = \frac{4}{9}$$

We can change the fraction more quickly by dividing both terms by their greatest common factor, 6.

A fraction is in its lowest terms when its numerator and denominator have no common factor.

Change to lowest terms :

2. $\frac{7}{35}$ $\frac{14}{30}$ $\frac{27}{33}$ $\frac{35}{40}$ $\frac{21}{36}$ $\frac{8}{30}$ $\frac{20}{28}$ $\frac{22}{32}$ $\frac{24}{36}$ $\frac{21}{42}$
3. $\frac{12}{36}$ $\frac{36}{36}$ $\frac{12}{40}$ $\frac{14}{42}$ $\frac{12}{44}$ $\frac{16}{42}$ $\frac{20}{42}$ $\frac{22}{36}$ $\frac{24}{40}$ $\frac{16}{44}$
4. $\frac{20}{45}$ $\frac{24}{32}$ $\frac{18}{36}$ $\frac{24}{60}$ $\frac{15}{45}$ $\frac{27}{42}$ $\frac{18}{45}$ $\frac{26}{40}$ $\frac{42}{44}$ $\frac{26}{48}$

Written

5. $\frac{40}{80}$ 6. $\frac{64}{72}$ 7. $\frac{54}{66}$ 8. $\frac{63}{69}$ 9. $\frac{36}{88}$
10. $\frac{70}{85}$ 11. $\frac{56}{84}$ 12. $\frac{52}{78}$ 13. $\frac{76}{84}$ 14. $\frac{56}{88}$
15. $\frac{88}{96}$ 16. $\frac{60}{105}$ 17. $\frac{84}{120}$ 18. $\frac{54}{276}$ 19. $\frac{22}{185}$
20. $\frac{26}{144}$ 21. $\frac{70}{315}$ 22. $\frac{256}{896}$ 23. $\frac{252}{280}$ 24. $\frac{128}{632}$
25. $\frac{112}{120}$ 26. $\frac{136}{276}$ 27. $\frac{216}{252}$ 28. $\frac{262}{1089}$ 29. $\frac{516}{1280}$

CHANGING IMPROPER FRACTIONS TO WHOLE OR MIXED NUMBERS

A fraction whose numerator is equal to or greater than its denominator is an improper fraction; as, $\frac{2}{2}$, $\frac{5}{5}$, $\frac{4}{3}$, $\frac{7}{5}$.

A number made up of a whole number and a fraction is a mixed number; as, $2\frac{1}{2}$, $3\frac{5}{8}$.

Oral

1. Change $2\frac{2}{5}$ to a mixed number.

Since there are 5 fifths in one unit, in 22 fifths there are as many units as there are 5's in 22; that is, 4 units and 2 fifths of a unit.

Change to whole or mixed numbers:

2. $\frac{4}{4}$ $\frac{18}{5}$ $\frac{19}{7}$ $\frac{25}{6}$ $\frac{48}{8}$ $\frac{27}{4}$ $\frac{88}{8}$ $\frac{56}{7}$
 3. $\frac{68}{10}$ $\frac{55}{6}$ $\frac{48}{8}$ $\frac{50}{7}$ $\frac{72}{12}$ $\frac{84}{7}$ $\frac{75}{5}$ $\frac{69}{11}$
 4. $\frac{50}{2}$ pints $\frac{82}{8}$ yards $\frac{55}{7}$ weeks $\frac{45}{8}$ dollars $\$ \frac{58}{8}$
 5. $\frac{48}{8}$ bushels $\frac{85}{9}$ miles $\frac{60}{5}$ acres $\frac{97}{12}$ dozen $\$ \frac{42}{5}$

Written

6. $\frac{567}{12}$ 7. $\frac{135}{8}$ 8. $\frac{120}{16}$ 9. $\frac{124}{82}$ bu. 10. $\frac{105}{24}$ days
 11. $\frac{157}{9}$ 12. $\frac{107}{15}$ 13. $\frac{111}{18}$ 14. $\frac{165}{7}$ wk. 15. $\frac{228}{60}$ hours
 16. $\frac{875}{32}$ 17. $\frac{157}{40}$ 18. $\frac{258}{25}$ 19. $\frac{168}{16}$ lb. 20. $\frac{125}{8}$ pecks
 21. $\frac{250}{30}$ 22. $\frac{225}{17}$ 23. $\frac{882}{19}$ 24. $\$ \frac{248}{50}$ 25. $\frac{647}{12}$ years

CHANGING WHOLE OR MIXED NUMBERS TO IMPROPER FRACTIONS

Oral

1. Change 2 to a fraction with 3 for a denominator.
 $2 = \frac{2}{1} = \frac{6}{3}$
 2. Change to halves: 1 3 5 6 8
 3. Change to tenths: 1 4 6 8 10
 4. Change to twentieths: 1 2 4 5 10

5. Change $4\frac{5}{8}$ to an improper fraction.

$$4\frac{5}{8} = \frac{27}{8}$$

$$1 = \frac{8}{8}; 4 = \frac{32}{8}; \frac{5}{8} + \frac{32}{8} = \frac{37}{8}$$

Tell how to change a whole or mixed number to an improper fraction.

Change to improper fractions :

6. $2\frac{1}{2}$	7. $3\frac{3}{8}$	8. $2\frac{1}{4}$	9. $1\frac{1}{2}$	10. $7\frac{3}{4}$	11. $9\frac{5}{8}$
12. $8\frac{3}{4}$	13. $7\frac{3}{8}$	14. $5\frac{2}{10}$	15. $6\frac{7}{12}$	16. $8\frac{4}{11}$	17. $4\frac{7}{20}$
<i>Written</i>					
18. $16\frac{1}{2}$	19. $15\frac{3}{4}$	20. $18\frac{3}{4}$	21. $16\frac{3}{8}$	22. $17\frac{1}{8}$	
23. $24\frac{3}{8}$	24. $19\frac{1}{2}$	25. $26\frac{5}{8}$	26. $17\frac{5}{8}$	27. $20\frac{1}{4}$	
28. $32\frac{5}{8}$	29. $48\frac{5}{8}$	30. $67\frac{7}{10}$	31. $37\frac{9}{11}$	32. $27\frac{5}{12}$	
33. $45\frac{7}{12}$	34. $42\frac{8}{15}$	35. $55\frac{9}{16}$	36. $29\frac{1}{18}$	37. $45\frac{1}{24}$	

REVIEW EXERCISE

Oral

1. Change 1, 2, 3, 4, 5 to fractions with 8 for a denominator.

2. What are such fractions called?

3. Name five fractions each equal to 1.

4. Name five fractions each equal to $\frac{3}{4}$.

5. Name all the fractions equal to $\frac{1}{10}$ having two figures in the denominator.

6. Change to lowest terms: $\frac{2}{2}$ $\frac{2}{6}$ $\frac{10}{15}$ $\frac{15}{25}$ $\frac{12}{20}$ $\frac{16}{27}$
 $\frac{9}{25}$ $\frac{12}{54}$ $\frac{70}{90}$ $\frac{36}{60}$ $\frac{35}{60}$ $\frac{42}{56}$ $\frac{54}{81}$ $\frac{60}{72}$

7. When is a fraction in its lowest terms?

8. Change to 20ths: $\frac{1}{2}$ $\frac{3}{4}$ $\frac{4}{5}$ $\frac{7}{10}$ $\frac{6}{10}$ $\frac{21}{20}$ $\frac{24}{80}$ $\frac{25}{100}$

9. Change to 100ths: $\frac{1}{2}$ $\frac{3}{4}$ $\frac{3}{5}$ $\frac{7}{10}$ $\frac{9}{20}$ $\frac{24}{25}$ $\frac{11}{50}$

10. Changed to mixed numbers: $\frac{20}{3}$ $\frac{27}{8}$ $\frac{40}{7}$ $\frac{53}{8}$ $\frac{67}{12}$

11. Change to improper fractions: $3\frac{2}{5}$ $5\frac{3}{8}$ $7\frac{5}{9}$ $8\frac{1}{4}$ $5\frac{5}{13}$

ADDITION OF FRACTIONS

Oral

1. Count by $\frac{1}{2}$'s to 6.

2. Count by $1\frac{1}{2}$'s to 15.

Thus, $\frac{1}{2}$, 1, $1\frac{1}{2}$, etc.

3. Count by $2\frac{1}{2}$'s to 30.

4. Count by $\frac{1}{4}$'s to 3.

5. Count by $1\frac{1}{4}$'s to 15.

6. Count by $2\frac{1}{4}$'s to 27.

7. Count by $\frac{1}{8}$'s to 4.

8. Count by $1\frac{1}{8}$'s to 16.

9. Count by $2\frac{1}{8}$'s to 28.

10. What change must be made before $\frac{1}{2}$ can be added to $\frac{1}{4}$? Why?

11. Add $\frac{1}{2}$ to: $\frac{1}{4}$ $\frac{3}{4}$ $\frac{1}{8}$ $\frac{5}{8}$ $\frac{1}{10}$ $\frac{7}{10}$ $\frac{1}{12}$ $\frac{1}{16}$

12. Add $\frac{1}{3}$ to: $\frac{1}{6}$ $\frac{5}{6}$ $\frac{1}{9}$ $\frac{4}{9}$ $\frac{8}{9}$ $\frac{1}{12}$ $\frac{5}{12}$ $\frac{7}{16}$

13. Add $\frac{1}{4}$ to: $\frac{1}{8}$ $\frac{5}{8}$ $\frac{1}{12}$ $\frac{5}{12}$ $\frac{11}{12}$ $\frac{1}{16}$ $\frac{5}{16}$ $\frac{9}{16}$

14. Add $\frac{1}{5}$ to: $\frac{1}{10}$ $\frac{3}{10}$ $\frac{7}{10}$ $\frac{1}{15}$ $\frac{4}{15}$ $\frac{2}{20}$ $\frac{3}{20}$ $\frac{19}{20}$

Add:

$$\begin{array}{r} 15. \quad 1\frac{1}{2} \\ \quad 3\frac{1}{2} \\ \quad 2\frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 16. \quad 2\frac{3}{4} \\ \quad 1\frac{1}{4} \\ \quad 5\frac{1}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 17. \quad 3\frac{1}{2} \\ \quad 1\frac{1}{4} \\ \quad 2\frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 18. \quad 2\frac{1}{2} \\ \quad 3\frac{3}{4} \\ \quad 2\frac{3}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 19. \quad 2\frac{1}{3} \\ \quad 1\frac{1}{2} \\ \quad 1\frac{1}{3} \\ \hline \end{array}$$

$$\begin{array}{r} 20. \quad 2\frac{1}{5} \\ \quad 3\frac{7}{10} \\ \quad 2\frac{3}{5} \\ \hline \end{array}$$

$$\begin{array}{r} 21. \quad 1\frac{5}{8} \\ \quad 2\frac{3}{8} \\ \quad 1\frac{1}{8} \\ \hline \end{array}$$

$$\begin{array}{r} 22. \quad 3\frac{1}{8} \\ \quad 3\frac{1}{6} \\ \quad 3\frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 23. \quad 4\frac{2}{5} \\ \quad 3\frac{1}{2} \\ \quad 6\frac{4}{5} \\ \hline \end{array}$$

$$\begin{array}{r} 24. \quad 7\frac{1}{2} \\ \quad 2\frac{3}{8} \\ \quad 2\frac{1}{2} \\ \hline \end{array}$$

Written

25. Add $\frac{3}{4}$, $\frac{2}{5}$, and $\frac{5}{12}$.

c. d. = 60

$$\frac{3}{4} = \frac{45}{60}$$

$$\frac{2}{5} = \frac{24}{60}$$

$$\frac{5}{12} = \frac{25}{60}$$

$$\frac{34}{60} = 1\frac{34}{60} = 1\frac{17}{30}$$

The least common multiple of the denominators 4, 5, and 12 is 60. Express $\frac{3}{4}$, $\frac{2}{5}$, and $\frac{5}{12}$ as 60ths.

Always change the fraction in the answer to its lowest terms.

To add fractions, change the fractions to equivalent fractions having a common denominator, and write the sum of the numerators over the common denominator.

Solve:

- | | | | |
|--|-----------------------------------|---|-----------------------------------|
| 26. $\frac{3}{4} + \frac{7}{8}$ | 27. $\frac{8}{15} + \frac{4}{6}$ | 28. $\frac{2}{3} + \frac{5}{14}$ | 29. $\frac{9}{20} + \frac{3}{4}$ |
| 30. $\frac{4}{6} + \frac{1}{2}$ | 31. $\frac{2}{6} + \frac{5}{6}$ | 32. $\frac{3}{8} + \frac{2}{8}$ | 33. $\frac{2}{8} + \frac{3}{4}$ |
| 34. $\frac{3}{4} + \frac{5}{6}$ | 35. $\frac{5}{6} + \frac{7}{9}$ | 36. $\frac{5}{12} + \frac{8}{9}$ | 37. $\frac{5}{8} + \frac{7}{12}$ |
| 38. $\frac{7}{10} + \frac{3}{4}$ | 39. $\frac{8}{10} + \frac{5}{6}$ | 40. $\frac{7}{12} + \frac{3}{20}$ | 41. $\frac{5}{16} + \frac{7}{12}$ |
| 42. $\frac{2}{9} + \frac{3}{8}$ | 43. $\frac{5}{12} + \frac{7}{15}$ | 44. $\frac{7}{12} + \frac{5}{18}$ | 45. $\frac{9}{20} + \frac{8}{15}$ |
| 46. $\frac{1}{2} + \frac{3}{8} + \frac{7}{16}$ | | 47. $\frac{1}{2} + \frac{3}{4} + \frac{7}{8} + \frac{9}{16}$ | |
| 48. $\frac{1}{6} + \frac{5}{18} + \frac{2}{9}$ | | 49. $\frac{1}{2} + \frac{1}{3} + \frac{3}{4} + \frac{5}{6}$ | |
| 50. $\frac{5}{8} + \frac{2}{3} + \frac{5}{6}$ | | ✓ 51. $\frac{1}{2} + \frac{2}{3} + \frac{5}{6} + \frac{5}{6}$ | |
| 52. $\frac{3}{4} + \frac{4}{6} + \frac{7}{10}$ | | ✗ 53. $\frac{2}{3} + \frac{3}{4} + \frac{5}{8} + \frac{1}{6}$ | |
| 54. $\frac{7}{9} + \frac{1}{2} + \frac{3}{4}$ | | 55. $\frac{3}{8} + \frac{2}{6} + \frac{5}{6} + \frac{7}{10}$ | |

ADDITION OF MIXED NUMBERS

Written

1. Add $8\frac{5}{8}$ and $2\frac{3}{8}$.

$$\begin{array}{r} c. d. = 24 \\ 8\frac{5}{8} = 8\frac{20}{24} \\ 2\frac{3}{8} = 2\frac{9}{24} \\ \hline 11\frac{29}{24} \end{array}$$

Changing $\frac{5}{8}$ and $\frac{3}{8}$ to similar fractions, we get $\frac{20}{24}$ and $\frac{9}{24}$.

$\frac{20}{24} + \frac{9}{24} = \frac{29}{24} = 1\frac{5}{6}$. Write the $\frac{5}{6}$ and add 1 to the units.

Solve:

- | | | | |
|--|-------------------------------------|---|-------------------------------------|
| 2. $2\frac{5}{12} + 3\frac{1}{4}$ | 3. $2\frac{5}{8} + 8\frac{1}{4}$ | 4. $3\frac{4}{9} + 7\frac{5}{12}$ | 5. $5\frac{3}{10} + 7\frac{8}{15}$ |
| 6. $7\frac{5}{8} + 4\frac{2}{10}$ | 7. $6\frac{3}{8} + 9\frac{7}{12}$ | 8. $5\frac{3}{8} + 4\frac{2}{6}$ | 9. $6\frac{5}{8} + 7\frac{7}{12}$ |
| 10. $7\frac{7}{12} + 8\frac{4}{15}$ | 11. $8\frac{3}{10} + 8\frac{7}{15}$ | 12. $9\frac{4}{9} + 8\frac{3}{8}$ | 13. $5\frac{4}{6} + 2\frac{3}{4}$ |
| 14. $4\frac{2}{7} + 5\frac{3}{4}$ | 15. $6\frac{7}{10} + 5\frac{4}{25}$ | 16. $8\frac{3}{8} + 6\frac{7}{10}$ | 17. $9\frac{4}{15} + 8\frac{7}{20}$ |
| 18. $\$12\frac{4}{5} + \$3\frac{7}{10} + \$18\frac{9}{20}$ | | 19. $4\frac{3}{4} + 7\frac{2}{3} + 8\frac{5}{6}$ | |
| 20. $15\frac{3}{4} + 20\frac{5}{8} + 10\frac{7}{16}$ | | 21. $12\frac{2}{3} + 3\frac{4}{6} + 2\frac{7}{15} + 4\frac{2}{5}$ | |
| 22. $2\frac{3}{5} + 8\frac{7}{15} + 10\frac{1}{2} + 15\frac{2}{3}$ | | 23. $1\frac{3}{4} + 2\frac{7}{8} + 4\frac{5}{16} + 6\frac{1}{2}$ | |

DRILL EXERCISE *Oral and Written*

	A	B	C	D
1.	$\frac{5}{8} + \frac{1}{2}$	$\frac{5}{12} + \frac{3}{4}$	$\frac{1}{2} + \frac{7}{10}$	$\frac{4}{5} + \frac{3}{8}$
2.	$\frac{2}{3} + \frac{3}{4}$	$\frac{2}{5} + \frac{1}{2}$	$\frac{3}{4} + \frac{7}{9}$	$\frac{5}{8} + \frac{4}{5}$
3.	$\frac{3}{4} + \frac{4}{5}$	$\frac{1}{2} + \frac{5}{7}$	$\frac{2}{5} + \frac{5}{6}$	$\frac{2}{3} + \frac{5}{8}$
4.	$\frac{1}{4} + \frac{5}{6}$	$\frac{3}{8} + \frac{1}{6}$	$\frac{5}{8} + \frac{3}{10}$	$\frac{1}{6} + \frac{3}{8}$
5.	$\frac{7}{15} + \frac{2}{3}$	$\frac{3}{4} + \frac{7}{10}$	$\frac{2}{3} + \frac{4}{5}$	$\frac{5}{8} + \frac{7}{12}$
6.	$\frac{7}{12} + \frac{8}{15}$	$\frac{5}{6} + \frac{7}{15}$	$\frac{1}{6} + \frac{1}{14}$	$\frac{5}{6} + \frac{7}{10}$
7.	$3\frac{7}{10} + \frac{2}{3}$	$2\frac{5}{6} + \frac{3}{4}$	$3\frac{3}{4} + 3\frac{3}{8}$	$4\frac{2}{3} + 5\frac{4}{9}$
8.	$1\frac{3}{10} + 1\frac{8}{15}$	$1\frac{5}{9} + 3\frac{7}{12}$	$5\frac{5}{6} + 4\frac{7}{10}$	$3\frac{3}{4} + 5\frac{2}{14}$
9.	$3\frac{5}{12} + 4\frac{7}{15}$	$2\frac{3}{4} + 5\frac{7}{9}$	$2\frac{8}{10} + 3\frac{4}{25}$	$3\frac{5}{12} + 4\frac{7}{20}$
10.	$1\frac{3}{20} + 6\frac{5}{24}$	$2\frac{7}{12} + 4\frac{3}{27}$	$6\frac{4}{9} + 3\frac{11}{12}$	$4\frac{5}{18} + 2\frac{7}{20}$

PROBLEMS*Oral and Written*

1. James sold $\frac{1}{3}$ of a box of corncakes one day and $\frac{1}{4}$ of a box the next. What part of a box on both days?

2. The charge for one telephone message was \$ $\frac{2}{3}$ and for another \$ $\frac{1}{4}$. What part of a dollar did both cost?

3. Mrs. Jenkins canned $\frac{2}{3}$ of a crate of blueberries on Tuesday and $\frac{1}{2}$ of a crate on Wednesday. How many crates did she can in all?

4. Henry walked $1\frac{1}{2}$ miles in going to school, $\frac{3}{4}$ of a mile on an errand, and $2\frac{1}{4}$ miles in the woods. How many miles in all?

5. Susie bought $\frac{1}{6}$ of a dozen oranges, Mary $\frac{1}{3}$ of a dozen, and Harriet $\frac{1}{4}$ of a dozen. What part of a dozen did they all buy?

6. How much must I pay for a pair of shoes at \$ $3\frac{1}{2}$, a pair of rubbers at \$ $\frac{4}{5}$, and a rubber coat at \$ $5\frac{3}{4}$.

7. Chester put in his barn an electric bell to be rung from the house. The bell cost $\$ \frac{3}{8}$, the wire $\$ \frac{1}{4}$, the battery $\$ \frac{1}{2}$, and the button $\$ \frac{1}{10}$. How much did he pay for materials?

8. Last year Mr. Stone used $5\frac{3}{4}$ cords of wood, and this year $1\frac{1}{2}$ cords more. How many cords this year? How many cords in both years?

SUBTRACTION OF FRACTIONS

Oral

1. Take $\frac{1}{2}$ from : 1 $\frac{3}{4}$ $\frac{5}{8}$ $\frac{7}{8}$ $\frac{9}{10}$ $\frac{11}{12}$ $\frac{9}{14}$ $\frac{11}{16}$

2. Take $\frac{1}{3}$ from : 1 $\frac{5}{6}$ $\frac{4}{9}$ $\frac{7}{9}$ $\frac{5}{12}$ $\frac{11}{12}$ $\frac{7}{15}$ $\frac{5}{18}$

3. Take $\frac{1}{4}$ from : 1 $\frac{5}{8}$ $\frac{7}{8}$ $\frac{7}{12}$ $\frac{11}{12}$ $\frac{7}{16}$ $\frac{15}{16}$ $\frac{11}{20}$

4. Take $\frac{1}{5}$ from : 1 $\frac{3}{10}$ $\frac{7}{10}$ $\frac{8}{15}$ $\frac{11}{15}$ $\frac{2}{20}$ $\frac{9}{20}$ $\frac{7}{20}$

5. From 10 take :

$\frac{3}{8}$ $\frac{2}{9}$ $\frac{7}{10}$ $\frac{5}{12}$ $1\frac{1}{2}$ $2\frac{1}{3}$ $3\frac{1}{6}$ $3\frac{5}{8}$ $4\frac{1}{4}$ $6\frac{1}{8}$

6. Subtract $\frac{7}{10}$ from $\frac{5}{8}$.

c. d. = 30.

$$\frac{5}{8} = \frac{25}{30}$$

$$\frac{7}{10} = \frac{21}{30}$$

$$\frac{4}{30} = \frac{2}{15}$$

Express $\frac{5}{8}$ and $\frac{7}{10}$ as similar fractions. $\frac{11}{16} - \frac{11}{16}$
 $= \frac{1}{16}$; $\frac{7}{10} = \frac{14}{20}$.

To subtract fractions, change the fractions to equivalent fractions having a common denominator, and write the difference of the numerators over the common denominator.

Solve :

Written

- | | | | |
|----------------------------------|-----------------------------------|------------------------------------|-----------------------------------|
| 7. $\frac{7}{8} - \frac{5}{8}$ | 8. $\frac{4}{9} - \frac{5}{18}$ | 9. $\frac{11}{15} - \frac{3}{5}$ | 10. $\frac{5}{8} - \frac{5}{24}$ |
| 11. $\frac{2}{3} - \frac{3}{10}$ | 12. $\frac{9}{10} - \frac{5}{8}$ | 13. $\frac{8}{9} - \frac{2}{3}$ | 14. $\frac{5}{6} - \frac{3}{8}$ |
| 15. $\frac{4}{5} - \frac{3}{8}$ | 16. $\frac{7}{8} - \frac{3}{10}$ | 17. $\frac{8}{9} - \frac{5}{6}$ | 18. $\frac{7}{10} - \frac{1}{6}$ |
| 19. $\frac{3}{4} - \frac{3}{10}$ | 20. $\frac{11}{12} - \frac{5}{8}$ | 21. $\frac{7}{12} - \frac{5}{9}$ | 22. $\frac{1}{15} - \frac{1}{20}$ |
| 23. $\frac{7}{8} - \frac{1}{6}$ | 24. $\frac{9}{10} - \frac{5}{12}$ | 25. $\frac{11}{15} - \frac{5}{12}$ | 26. $\frac{5}{12} - \frac{7}{18}$ |

SUBTRACTION OF MIXED NUMBERS

Written

1. Subtract $3\frac{5}{8}$ from $8\frac{3}{10}$.

c. d. = 30

$$8\frac{3}{10} = 8\frac{9}{30} = 7\frac{29}{30}$$

$$3\frac{5}{8} = \quad = 3\frac{15}{24}$$

$$4\frac{14}{30} = 4\frac{7}{15}$$

Expressing the fractions $\frac{3}{10}$ and $\frac{5}{8}$ as similar fractions, we get $\frac{9}{30}$ and $\frac{15}{24}$. Since $\frac{15}{24}$ cannot be taken from $\frac{9}{30}$, we take 1 from the 8, express it as $\frac{24}{24}$, and add it to the $\frac{9}{30}$, making $\frac{33}{30}$. $\frac{33}{30} - \frac{15}{24} = \frac{14}{30}$, or $\frac{7}{15}$.

Solve:

2. $16\frac{5}{8} - 8\frac{3}{4}$

3. $12\frac{1}{4} - 3\frac{2}{5}$

4. $12\frac{1}{5} - 3\frac{1}{2}$

5. $15\frac{3}{8} - 3\frac{2}{5}$

6. $12\frac{5}{8} - 8\frac{5}{8}$

7. $17\frac{1}{8} - 5\frac{1}{8}$

8. $33\frac{7}{15} - 2\frac{3}{10}$

9. $48\frac{3}{4} - 2\frac{1}{5}$

10. $12\frac{5}{16} - 6\frac{5}{16}$

11. $18\frac{9}{20} - 3\frac{5}{8}$

12. $17\frac{6}{25} - 8\frac{7}{10}$

13. $27\frac{5}{12} - 2\frac{1}{12}$

14. $10\frac{3}{7} - 3\frac{3}{4}$

15. $25\frac{7}{8} - 10\frac{7}{10}$

16. $16\frac{5}{12} - 14\frac{7}{8}$

17. Which is the shorter distance, $\frac{5}{8}$ of a mile or $\frac{7}{8}$ of a mile? How much shorter?

18. What must be taken from $4\frac{1}{8}$ to leave $2\frac{3}{8}$?

19. What must be added to $5\frac{3}{8}$ to make $12\frac{3}{8}$?

20. \$12 $\frac{1}{2}$ is how much more than \$8 $\frac{1}{2}$?

21. Change $\frac{4}{5}$ and $\frac{3}{7}$ to lowest terms and find their difference.

PROBLEMS

Oral and Written

1. After selling $\frac{5}{8}$ of a farm, what part is left?

2. Ralph picked $\frac{5}{8}$ of a peck of cherries. He sold $\frac{1}{2}$ of a peck. What part of a peck had he then?

3. Isabel had \$ $\frac{4}{5}$. She bought a belt for \$ $\frac{1}{2}$. What part of a dollar had she left?

4. What part of a dollar did John lose by selling for \$ $\frac{1}{4}$ a knife which cost \$ $\frac{3}{8}$?

5. Roy earned \$1 $\frac{1}{2}$ and spent \$ $\frac{1}{2}$. What part of a dollar had he left?

6. One half of Mr. Arbin's land is a vegetable garden, $\frac{1}{3}$ is a flower garden, and the rest is in lawn. What part in lawn?

7. After selling $\frac{3}{4}$ of a bushel and $\frac{1}{2}$ of a bushel, what is left of a barrel of apples (2 $\frac{1}{2}$ bu.)?

8. Gladys is 12 $\frac{1}{8}$ years old, and her sister is 2 $\frac{1}{2}$ years younger. What is the sister's age?

9. One fourth of a farm is in pasture, $\frac{2}{3}$ in grass, and the rest in grain. What part in grain?

10. Harry earned \$3 a week for 5 weeks. He then bought a suit for \$12 $\frac{3}{4}$. How much had he left?

DRILL EXERCISE

Oral or Written

A

B

C

D

1.	$\frac{1}{2} + ? = \frac{3}{4}$	$? + \frac{3}{8} = \frac{7}{8}$	$\frac{3}{4} - ? = \frac{1}{2}$	$? - \frac{3}{4} = \frac{1}{2}$
2.	$\frac{2}{3} + ? = \frac{5}{6}$	$? + \frac{1}{2} = \frac{5}{6}$	$\frac{5}{8} - ? = \frac{1}{4}$	$? - \frac{5}{8} = \frac{1}{4}$
3.	$\frac{1}{4} + ? = 1\frac{1}{2}$	$? + \frac{3}{4} = \frac{4}{5}$	$\frac{5}{6} - ? = \frac{2}{3}$	$? - \frac{5}{6} = \frac{2}{3}$
4.	$\frac{2}{5} + ? = \frac{5}{8}$	$? + \frac{3}{8} = \frac{2}{3}$	$\frac{2}{5} - ? = \frac{1}{2}$	$? - \frac{2}{5} = \frac{1}{2}$
5.	$\frac{5}{6} + ? = 1\frac{1}{2}$	$? + \frac{4}{5} = 2$	$1\frac{1}{5} - ? = \frac{2}{5}$	$? - 1\frac{1}{5} = \frac{2}{5}$
6.	$\frac{3}{8} + ? = 2$	$? + \frac{2}{5} = 1$	$2 - ? = 1\frac{1}{4}$	$? - 2 = 1\frac{1}{4}$
7.	$\frac{7}{9} + ? = 1\frac{2}{3}$	$? + 2\frac{1}{3} = 3\frac{1}{4}$	$1\frac{1}{4} - ? = \frac{7}{8}$	$? - 1\frac{1}{4} = \frac{7}{8}$
8.	$2\frac{1}{6} + ? = 5\frac{1}{2}$	$? + 5\frac{1}{2} = 6\frac{1}{4}$	$3\frac{1}{4} - ? = 2\frac{1}{5}$	$? - 3\frac{1}{4} = 2\frac{1}{5}$
9.	$1\frac{3}{8} + ? = 2\frac{5}{6}$	$? + 1\frac{3}{4} = 2\frac{3}{8}$	$2\frac{3}{8} - ? = 1\frac{3}{4}$	$? - 2\frac{3}{8} = 1\frac{3}{4}$
10.	$1\frac{5}{8} + ? = 3\frac{1}{2}$	$? + 1\frac{5}{8} = 2\frac{1}{4}$	$3\frac{3}{8} - ? = 2\frac{1}{6}$	$? - 3\frac{3}{8} = 2\frac{1}{6}$

PROBLEMS

Oral and Written

1. A kerosene can holds 5 gallons. How much is left after 1 $\frac{3}{4}$ gallons have been drawn?

2. Mrs. Emerson paid $\$ \frac{3}{5}$ for eggs and $\$ \frac{3}{4}$ for sugar. How much for both?

3. A man's step is $2\frac{5}{12}$ feet, and his son's $1\frac{3}{8}$ feet. How much longer than the son's step is the father's?

4. A carpenter has a board $12\frac{3}{4}$ feet long with which to cover a space $10\frac{7}{8}$ feet long. How much must he cut off?

5. Albert spent $\frac{1}{2}$ of his money for a ball and $\frac{1}{5}$ of it for a bat. What part of his money had he left? How much had he left if he had 60 cents at first?

6. A tub of butter weighs $56\frac{1}{2}$ pounds. The tub weighs $3\frac{2}{16}$ pounds. What is the weight of the butter?

7. A man can saw $\frac{1}{2}$ of a pile of wood in a day, and a boy can saw $\frac{1}{3}$ of it. What part can both saw in a day?

8. In a storm at sea, $\frac{1}{4}$ of a cargo of fruit was thrown overboard and $\frac{2}{5}$ was spoiled. What part of the cargo was lost? What part was saved?

9. What is the perimeter of an envelope $6\frac{1}{2}$ inches long and $3\frac{3}{4}$ inches wide?

10. A seam $\frac{3}{16}$ of an inch wide is made on both sides of a strip of cloth 27 inches wide. What is the width of the strip after the seams are made?

11. A bat cost $\$ \frac{3}{10}$, a ball $\$ \frac{1}{5}$, and a pair of ball shoes $\$ 1\frac{1}{4}$. What was the change from a $\$ 5$ -bill?

12. From a piece of dress goods containing 60 yards there were sold $12\frac{3}{4}$ yards, $8\frac{5}{8}$ yards, $11\frac{7}{8}$ yards, and $19\frac{3}{4}$ yards. How many yards were left?

13. Spice bought at $27\frac{3}{4}$ cents a pound is sold at 42 cents a pound. What is the gain?

14. Coffee is sold for 88 cents a pound. The gain is $8\frac{1}{4}$ cents. What was the cost?

MULTIPLICATION OF FRACTIONS

Oral

1. 6 times 3 apples = ? 2. 6 times 3 sevenths = ?
 3. $6 \times \frac{3}{7} = 1\frac{2}{7} = 2\frac{1}{7}$.

Remember that the denominator simply names the fraction.

Solve:

- | | | | |
|----------------------------|-----------------------------|----------------------------|-----------------------------|
| 4. $7 \times \frac{1}{2}$ | 5. $6 \times \frac{2}{3}$ | 6. $5 \times \frac{3}{4}$ | 7. $8 \times \frac{3}{4}$ |
| 8. $4 \times \frac{3}{4}$ | 9. $10 \times \frac{3}{4}$ | 10. $4 \times \frac{3}{4}$ | 11. $20 \times \frac{3}{4}$ |
| 12. $8 \times \frac{3}{4}$ | 13. $7 \times \frac{5}{8}$ | 14. $6 \times \frac{5}{8}$ | 15. $8 \times \frac{1}{5}$ |
| 16. $7 \times \frac{2}{3}$ | 17. $6 \times \frac{4}{7}$ | 18. $7 \times \frac{2}{3}$ | 19. $12 \times \frac{3}{4}$ |
| 20. $5 \times \frac{3}{4}$ | 21. $10 \times \frac{4}{5}$ | 22. $7 \times \frac{5}{8}$ | 23. $16 \times \frac{3}{4}$ |

Written

- | | | | |
|------------------------------|------------------------------|------------------------------|------------------------------|
| 24. $15 \times \frac{3}{4}$ | 25. $29 \times \frac{3}{4}$ | 26. $20 \times \frac{5}{8}$ | 27. $17 \times \frac{8}{15}$ |
| 28. $28 \times \frac{1}{3}$ | 29. $25 \times \frac{5}{6}$ | 30. $24 \times \frac{8}{11}$ | 31. $24 \times \frac{3}{5}$ |
| 32. $18 \times \frac{5}{6}$ | 33. $27 \times \frac{8}{16}$ | 34. $45 \times \frac{7}{8}$ | 35. $37 \times \frac{7}{12}$ |
| 36. $11 \times \frac{5}{14}$ | 37. $32 \times \frac{7}{15}$ | 38. $27 \times \frac{5}{8}$ | 39. $35 \times \frac{9}{16}$ |
| 40. $14 \times \frac{7}{9}$ | 41. $25 \times \frac{5}{12}$ | 42. $40 \times \frac{4}{11}$ | 43. $43 \times \frac{8}{9}$ |

MULTIPLYING A WHOLE NUMBER BY A FRACTION *Oral*

1. Find $\frac{3}{4} \times 40$.

In the expression $\frac{3}{4} \times 8$ the sign \times is equivalent to the word "of."

Find:

- | | | | |
|-----------------------------|-----------------------------|-----------------------------|------------------------------|
| 2. $\frac{3}{8} \times 24$ | 3. $\frac{3}{4} \times 42$ | 4. $\frac{6}{11} \times 33$ | 5. $\frac{5}{9} \times 27$ |
| 6. $\frac{2}{3} \times 18$ | 7. $\frac{6}{7} \times 84$ | 8. $\frac{5}{6} \times 72$ | 9. $\frac{5}{12} \times 144$ |
| 10. $\frac{4}{5} \times 50$ | 11. $\frac{5}{8} \times 56$ | 12. $\frac{7}{9} \times 63$ | 13. $\frac{5}{8} \times 54$ |

Finding a fractional part of a number is called multiplying by a fraction.

14. $\frac{2}{5} \times 8$

$$\frac{1}{5} \text{ of } 8 = \frac{8}{5}; \frac{2}{5} \text{ of } 8 = \frac{16}{5} = 3\frac{1}{5}.$$

15. $\frac{2}{3} \times 7$

16. $\frac{3}{8} \times 5$

17. $\frac{3}{5} \times 8$

18. $\frac{3}{8} \times 1\frac{1}{2}$

19. $\frac{3}{4} \times 9$

20. $\frac{3}{5} \times 3$

21. $\frac{2}{3} \times 4$

22. $\frac{2}{9} \times 8$

23. $\frac{4}{5} \times 6$

24. $\frac{1}{7} \times 8$

25. $\frac{3}{11} \times 9$

26. $\frac{3}{4} \times 9$

27. $\frac{5}{6} \times 7$

28. $\frac{3}{10} \times 7$

29. $\frac{5}{12} \times 5$

30. $\frac{5}{8} \times 7$

31. $\frac{3}{7} \times 6$

32. $\frac{5}{11} \times 9$

33. $\frac{7}{12} \times 11$

34. $\frac{8}{9} \times 4$

Written

35. $\frac{1}{2} \times 45$

36. $\frac{2}{3} \times 25$

37. $\frac{3}{5} \times 19$

38. $\frac{2}{7} \times 22$

39. $\frac{3}{4} \times 19$

40. $\frac{5}{8} \times 15$

41. $\frac{7}{9} \times 40$

42. $\frac{3}{8} \times 37$

43. $\frac{5}{6} \times 23$

44. $\frac{4}{7} \times 30$

45. $\frac{3}{10} \times 39$

46. $\frac{5}{12} \times 41$

47. $\frac{6}{7} \times 45$

48. $\frac{4}{9} \times 50$

49. $\frac{5}{8} \times 53$

50. $\frac{8}{9} \times 64$

51. $\frac{7}{8} \times 81$

52. $\frac{7}{12} \times 71$

53. $\frac{5}{7} \times 80$

54. $\frac{7}{10} \times 83$

MULTIPLYING A FRACTION BY A FRACTION

1. $\frac{2}{3}$ of $\frac{3}{\text{days}} = ?$

2. $\frac{2}{3}$ of $\frac{2}{7} = ?$

$$\frac{1}{3} \text{ of } \frac{3}{\text{days}} = \frac{1}{\text{day}}$$

$$\frac{1}{3} \text{ of } \frac{2}{7} = \frac{1}{7}$$

$$\frac{2}{3} \text{ of } \frac{3}{\text{days}} = \frac{2}{\text{days}}$$

$$\frac{2}{3} \text{ of } \frac{2}{7} = \frac{2}{7}$$

If in finding the product of $\frac{2}{3} \times \frac{2}{7}$, the numerators are multiplied together for a new numerator, and the denominators multiplied together for a new denominator, the same result is obtained as in the process just described.

(1) $\frac{2 \times 3}{3 \times 7} = \frac{6}{21} = \frac{2}{7}$

(2) $\frac{2}{3} \times \frac{2}{7} = \frac{2}{7}$

To multiply a fraction by a fraction, write the product of the numerators over the product of the denominators, canceling when possible.

This rule applies to all cases of multiplication in fractions, for every whole number may be written as a fraction with 1 for its denominator. $\frac{2}{3} \times 15$ may be written $\frac{2}{3} \times \frac{15}{1}$; $15 \times \frac{2}{3} = \frac{15}{1} \times \frac{2}{3}$.

Oral

Solve:

- | | | | |
|--|--|---------------------------------------|---|
| 3. $\frac{2}{3} \times \frac{2}{4}$ | 4. $\frac{1}{2} \times \frac{15}{16}$ | 5. $\frac{4}{5} \times \frac{25}{4}$ | 6. $\frac{5}{8} \times \frac{4}{5}$ |
| 7. $\frac{5}{6} \times \frac{12}{5}$ | 8. $\frac{2}{3} \times \frac{5}{3}$ | 9. $\frac{2}{3} \times \frac{9}{4}$ | 10. $\frac{4}{5} \times \frac{5}{6}$ |
| 11. $\frac{2}{3} \times \frac{15}{8}$ | 12. $\frac{5}{6} \times \frac{12}{5}$ | 13. $\frac{7}{8} \times \frac{16}{5}$ | 14. $\frac{2}{3} \times \frac{36}{5}$ |
| 15. $\frac{2}{3} \times \frac{42}{5}$ | 16. $\frac{14}{5} \times \frac{2}{3}$ | 17. $\frac{5}{6} \times \frac{24}{5}$ | 18. $\frac{8}{9} \times \frac{27}{4}$ |
| 19. $\frac{22}{5} \times \frac{9}{11}$ | 20. $\frac{17}{4} \times \frac{7}{10}$ | 21. $\frac{8}{9} \times \frac{7}{4}$ | 22. $\frac{5}{12} \times \frac{15}{10}$ |
| 23. $\frac{4}{5} \times \frac{8}{15}$ | 24. $\frac{6}{9} \times \frac{17}{3}$ | 25. $\frac{4}{9} \times \frac{5}{6}$ | 26. $\frac{7}{8} \times \frac{9}{10}$ |

$$27. 2\frac{2}{3} \times 3\frac{1}{2} = \frac{8}{3} \times \frac{7}{2} = 10$$

Written

- | | | | |
|---|--|--|--|
| 28. $2\frac{1}{4} \times 2\frac{1}{2}$ | 29. $3\frac{2}{3} \times 1\frac{7}{5}$ | 30. $3\frac{1}{2} \times 4\frac{1}{2}$ | 31. $2\frac{3}{4} \times 1\frac{5}{11}$ |
| 32. $5\frac{5}{8} \times 4\frac{2}{3}$ | 33. $5\frac{1}{7} \times 1\frac{5}{9}$ | 34. $1\frac{3}{5} \times 2\frac{1}{3}$ | 35. $1\frac{9}{16} \times 1\frac{5}{25}$ |
| 36. $5\frac{2}{3} \times 1\frac{8}{5}$ | 37. $3\frac{1}{3} \times 4\frac{1}{5}$ | 38. $5\frac{1}{4} \times 1\frac{1}{3}$ | 39. $4\frac{2}{3} \times 2\frac{2}{3}$ |
| 40. $3\frac{1}{4} \times 2\frac{2}{3}$ | 41. $5\frac{2}{3} \times 1\frac{1}{4}$ | 42. $5\frac{5}{8} \times 1\frac{1}{2}$ | 43. $4\frac{2}{3} \times 2\frac{1}{7}$ |
| 44. $1\frac{5}{12} \times 4\frac{1}{6}$ | 45. $1\frac{7}{9} \times 5\frac{1}{4}$ | 46. $3\frac{5}{9} \times 2\frac{1}{3}$ | 47. $2\frac{2}{7} \times 5\frac{2}{5}$ |

48. Multiply $3\frac{3}{4}$ by 6.

$$\begin{array}{r} 3\frac{3}{4} \\ 6 \\ \hline 4\frac{1}{2} = 6 \times \frac{3}{4} \\ 18 = 6 \times 3 \\ \hline 22\frac{1}{2} \end{array}$$

49. Multiply 6 by $3\frac{3}{4}$.

$$\begin{array}{r} 6 \\ 3\frac{3}{4} \\ \hline 4\frac{1}{2} = \frac{3}{4} \times 6 \\ 18 = 3 \times 6 \\ \hline 22\frac{1}{2} \end{array}$$

In multiplying a mixed number by a whole number, or a whole number by a mixed number, we may multiply without changing the mixed number to an improper fraction.

Give products at sight :

- | | | | |
|-----------------------------|---------------------------------------|-----------------------------|-----------------------------|
| 50. $4 \times 2\frac{1}{2}$ | 51. $6\frac{1}{2} \times \frac{3}{4}$ | 52. $3 \times 2\frac{3}{4}$ | 53. $1\frac{1}{4} \times 7$ |
| 54. $5 \times 1\frac{1}{3}$ | 55. $1\frac{2}{3} \times 4$ | 56. $4 \times 1\frac{1}{4}$ | 57. $1\frac{3}{4} \times 4$ |
| 58. $6 \times 2\frac{2}{5}$ | 59. $2\frac{2}{5} \times 3$ | 60. $2 \times 2\frac{2}{5}$ | 61. $1\frac{1}{5} \times 3$ |

Written

Find :

- | | | | |
|-------------------------------|-------------------------------|-------------------------------|--------------------------------|
| 62. $5 \times 3\frac{1}{2}$ | 63. $12\frac{3}{8} \times 5$ | 64. $9 \times 8\frac{5}{8}$ | 65. $7\frac{5}{8} \times 12$ |
| 66. $12 \times 3\frac{1}{4}$ | 67. $8\frac{1}{4} \times 10$ | 68. $8 \times 5\frac{1}{4}$ | 69. $13\frac{3}{8} \times 9$ |
| 70. $9 \times 16\frac{3}{10}$ | 71. $14\frac{4}{5} \times 16$ | 72. $13 \times 6\frac{3}{8}$ | 73. $14\frac{3}{8} \times 22$ |
| 74. $15 \times 22\frac{3}{8}$ | 75. $20\frac{5}{8} \times 12$ | 76. $7 \times 16\frac{3}{4}$ | 77. $12\frac{5}{8} \times 18$ |
| 78. $40 \times 14\frac{3}{4}$ | 79. $15\frac{1}{4} \times 28$ | 80. $24 \times 15\frac{1}{8}$ | 81. $81\frac{5}{12} \times 84$ |

DRILL EXERCISES

Oral and Written

- | | | | | |
|--------------------------------------|-----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|
| 1. $\frac{1}{5}$ of $\frac{1}{8}$ | $\frac{1}{5}$ of $\frac{7}{8}$ | $\frac{2}{5}$ of $\frac{7}{8}$ | $\frac{4}{5}$ of $\frac{5}{18}$ | $\frac{3}{8}$ of 8 |
| 2. $\frac{1}{7}$ of $\frac{1}{6}$ | $\frac{1}{7}$ of $\frac{3}{8}$ | $\frac{2}{7}$ of $\frac{3}{8}$ | $\frac{3}{8}$ of $\frac{2}{4}$ | $\frac{2}{4}$ of $\frac{5}{8}$ |
| 3. $\frac{1}{9}$ of 27 | $\frac{1}{9}$ of $\frac{27}{8}$ | $\frac{4}{9}$ of $\frac{27}{8}$ | $\frac{5}{8}$ of $\frac{21}{4}$ | $\frac{5}{8}$ of $\frac{2}{20}$ |
| 4. $\frac{1}{6}$ of 12 | $\frac{1}{6}$ of $\frac{13}{8}$ | $\frac{5}{6}$ of $\frac{13}{8}$ | $\frac{2}{3}$ of $\frac{15}{8}$ | $\frac{6}{7}$ of $\frac{35}{8}$ |
| 5. $\frac{1}{8}$ of 11 | $\frac{1}{8}$ of $\frac{11}{5}$ | $\frac{5}{8}$ of $\frac{11}{5}$ | $\frac{5}{11}$ of $\frac{44}{5}$ | $\frac{7}{8}$ of $\frac{20}{8}$ |
| 6. $\frac{4}{5}$ of 20 | $\frac{4}{5}$ of $\frac{20}{11}$ | $\frac{3}{5}$ of $\frac{40}{11}$ | $\frac{3}{8}$ of $\frac{1}{2}$ | $\frac{8}{9}$ of 15 |
| 7. $\frac{2}{7}$ of $\frac{1}{8}$ | $\frac{2}{7}$ of $\frac{21}{8}$ | $\frac{5}{7}$ of $\frac{21}{8}$ | $\frac{7}{12}$ of $\frac{48}{11}$ | $\frac{70}{10}$ of $\frac{35}{8}$ |
| 8. $\frac{1}{3}$ of 11 | $\frac{1}{3}$ of $\frac{1}{2}$ | $\frac{2}{3}$ of 1 | $\frac{2}{3}$ of $\frac{1}{2}$ | $\frac{11}{12}$ of $\frac{13}{8}$ |
| 9. $\frac{1}{7}$ of 15 | $\frac{1}{7}$ of 4 | $\frac{1}{4}$ of 7 | $\frac{2}{4}$ of $\frac{15}{7}$ | $\frac{13}{18}$ of $\frac{30}{8}$ |
| 10. $\frac{5}{12}$ of $\frac{36}{5}$ | $\frac{2}{18}$ of $\frac{65}{11}$ | $\frac{8}{15}$ of $\frac{27}{8}$ | $\frac{1}{4}$ of 8 | $\frac{13}{14}$ of $\frac{42}{8}$ |

PROBLEMS

Oral and Written

1. How much must be paid for $\frac{7}{8}$ of a pound of steak at 32 cents a pound?
2. How many days in $\frac{5}{8}$ of the month of September?
3. A chair cost \$12 and a table $2\frac{2}{3}$ times as much. How much did the table cost?
4. Mabel had $\$ \frac{4}{5}$. She spent $\frac{5}{8}$ of it for a Dutch collar. What part of a dollar did the collar cost?
5. A street vender bought $2\frac{1}{2}$ bushels of chestnuts, and sold $\frac{2}{3}$ at once. What quantity did he sell?
6. A man earns $\$ 2\frac{3}{5}$ a day; how much in a week?
7. A farmer planted $3\frac{3}{4}$ acres to corn and $1\frac{1}{2}$ times as many acres to potatoes. How many acres to potatoes?
8. A dressmaker charged $\$ 5\frac{1}{4}$ for her labor, and $\frac{3}{4}$ as much for trimmings. How much for both?
9. The frames for my eyeglasses cost $\$ 4\frac{1}{2}$, and each of the lenses $\$ 1\frac{1}{4}$. What was the total cost?
10. After selling $\frac{2}{3}$ of a barrel of vinegar ($31\frac{1}{2}$ gallons), how many gallons has the grocer left?

DIVISION OF FRACTIONS

1. $\frac{6}{\text{apples}} \div \frac{2}{\text{apples}} = ?$
2. $\frac{6}{\text{sevenths}} \div \frac{2}{\text{sevenths}} = ?$
3. $\frac{6}{7} \div \frac{2}{7} = ?$
4. $\frac{6}{7} \div \frac{2}{7} = ?$
5. $\frac{6}{7} \div \frac{2}{7} = ?$
6. $\frac{6}{7} \div \frac{2}{7} = ?$
7. $\frac{2}{3} \div \frac{2}{3} = ?$ Change to like fractions.

$$\frac{21}{2} \div \frac{12}{2} = 21 \div 12 = 1\frac{9}{12} = 1\frac{3}{4}$$

Any number may be divided by a fraction by changing both numbers to like fractions and then dividing the numerator of the dividend by the numerator of the divisor.

8. Divide 6 by $\frac{2}{5}$ $\frac{a}{b} = \frac{a}{b}$, for any whole number may be expressed as a fraction with 1 for its denominator.

$$\frac{6}{1} \div \frac{2}{5} \quad \text{Change to like fractions.}$$

$$\frac{30}{5} \div \frac{2}{5} = 10$$

9. Divide $\frac{3}{8}$ by 2.

$$\frac{3}{8} \div \frac{2}{1} \quad \text{Change to like fractions.}$$

$$\frac{3}{8} \div \frac{16}{8} = 3 \div 16 = \frac{3}{16}$$

By multiplying the dividend by the divisor inverted, the same result is obtained as in the process just described.

Thus, $\frac{3}{4} \div \frac{3}{7} = \frac{3}{4} \times \frac{7}{3} = \frac{7}{4} = 1\frac{3}{4}$

$$6 \div \frac{3}{5} = \frac{6}{1} \times \frac{5}{3} = 10$$

$$\frac{3}{8} \div 2 = \frac{3}{8} \times \frac{1}{2} = \frac{3}{16}$$

To divide fractions, change to like fractions and divide the numerator of the dividend by the numerator of the divisor; or, for convenience, invert the divisor and multiply, canceling when possible.

Solve:

Written

- | | | | |
|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|
| 10. $\frac{3}{4} \div 6$ | 11. $\frac{7}{8} \div 14$ | 12. $\frac{9}{10} \div 15$ | 13. $\frac{5}{12} \div 10$ |
| 14. $\frac{7}{8} \div 21$ | 15. $\frac{8}{15} \div 12$ | 16. $\frac{5}{9} \div 5$ | 17. $\frac{8}{13} \div 16$ |
| 18. $2 \div \frac{3}{4}$ | 19. $10 \div \frac{4}{5}$ | 20. $15 \div \frac{3}{8}$ | 21. $18 \div \frac{6}{7}$ |
| 22. $16 \div \frac{8}{15}$ | 23. $14 \div \frac{7}{20}$ | 24. $9 \div \frac{6}{7}$ | 25. $14 \div \frac{7}{8}$ |
| 26. $\frac{14}{15} \div \frac{4}{5}$ | 27. $\frac{2}{3} \div \frac{3}{5}$ | 28. $\frac{7}{8} \div \frac{12}{13}$ | 29. $\frac{2}{3} \div \frac{4}{7}$ |
| 30. $\frac{3}{20} \div \frac{3}{8}$ | 31. $\frac{8}{20} \div \frac{9}{10}$ | 32. $\frac{4}{25} \div \frac{8}{15}$ | 33. $\frac{7}{18} \div \frac{4}{27}$ |
| 34. $\frac{3}{4} \div \frac{15}{8}$ | 35. $\frac{8}{9} \div \frac{1}{6}$ | 36. $\frac{7}{10} \div \frac{4}{5}$ | 37. $\frac{5}{12} \div \frac{9}{10}$ |

38. $2\frac{2}{3} + 1\frac{1}{3}$

$$2\frac{2}{3} + 1\frac{1}{3} = \frac{8}{3} + \frac{4}{3} = \frac{8}{3} \times \frac{2}{2} \times \frac{3}{4} = 2$$

39. $1\frac{2}{3} + 10$

40. $2\frac{1}{2} + \frac{4}{5}$

41. $\frac{2}{3} + 1\frac{1}{2}$

42. $1\frac{2}{3} + 2\frac{1}{3}$

43. $1\frac{1}{5} + 18$

44. $1\frac{3}{8} + \frac{2}{3}$

45. $\frac{4}{7} + 1\frac{1}{2}$

46. $1\frac{1}{2} + 1\frac{1}{4}$

47. $2\frac{1}{8} + 21$

48. $2\frac{1}{7} + \frac{1}{2}$

49. $\frac{3}{8} + 1\frac{1}{8}$

50. $2\frac{1}{8} + 3\frac{1}{4}$

51. $3\frac{5}{8} + 2$

52. $3\frac{1}{2} + \frac{7}{8}$

53. $\frac{7}{15} + 2\frac{1}{2}$

54. $3\frac{1}{4} + 2\frac{1}{5}$

55. $6\frac{3}{4} + 5$

56. $2\frac{1}{3} + \frac{7}{9}$

57. $\frac{4}{9} + 3\frac{1}{2}$

58. $2\frac{2}{5} + 1\frac{2}{8}$

59. $8\frac{1}{2} + 3$

60. $4\frac{1}{5} + 1\frac{4}{5}$

61. $\frac{5}{6} + 1\frac{1}{6}$

62. $4\frac{1}{8} + 3\frac{3}{8}$

63. $2\frac{5}{8} + 7$

64. $5\frac{3}{8} + \frac{7}{8}$

65. $\frac{4}{5} + 4\frac{1}{5}$

66. $3\frac{2}{3} + 5\frac{1}{2}$

67. $3\frac{3}{8} + 9$

68. $1\frac{2}{3} + 3\frac{1}{2}$

69. $\frac{3}{4} + 2\frac{2}{4}$

70. $2\frac{4}{5} + 1\frac{1}{4}$

71. $2\frac{5}{7} + 4$

72. $3\frac{1}{2} + \frac{2}{3}$

73. $\frac{7}{10} + 3\frac{1}{2}$

74. $3\frac{2}{3} + 1\frac{2}{3}$

75. $4\frac{2}{5} + 11$

76. $4\frac{4}{5} + \frac{4}{5}$

77. $\frac{9}{20} + 12\frac{1}{2}$

78. $1\frac{1}{5} + 3\frac{2}{5}$

79. $15\frac{3}{7} + 4$

$$(1) \begin{array}{r} 4 \overline{) 15\frac{3}{7}} \\ \underline{3\frac{4}{7}} \end{array}$$

4 in 15, 3 times, and 3 over. $3\frac{4}{7} = 3\frac{4}{7}$; $\frac{1}{7}$ of $3\frac{4}{7} = \frac{4}{7}$

$$(2) 15\frac{3}{7} + 4 = \frac{108}{7} \times \frac{1}{4} = \frac{27}{7} = 3\frac{6}{7}$$

80. $8\frac{2}{5} + 3$

81. $9\frac{4}{7} + 8$

82. $6\frac{2}{10} + 4$

83. $7\frac{2}{3} + 3$

84. $7\frac{1}{2} + 6$

85. $7\frac{2}{10} + 4$

86. $9\frac{4}{5} + 7$

87. $7\frac{2}{16} + 4$

88. $16\frac{5}{8} + 7$

89. $12\frac{2}{4} + 4$

90. $24\frac{2}{3} + 9$

91. $15\frac{1}{5} + 7$

92. $20\frac{5}{8} + 9$

93. $12\frac{1}{2} + 8$

94. $27\frac{2}{8} + 6$

95. $17\frac{2}{7} + 3$

96. $28\frac{2}{4} + 5$

97. $25\frac{2}{5} + 6$

98. $30\frac{5}{8} + 3$

99. $50\frac{1}{3} + 12$

PROBLEMS

Written

1. Mrs. Anderson paid \$2 $\frac{1}{2}$ for braid at \$ $\frac{1}{4}$ a yard. How many yards did she buy?

2. How long will it take to earn \$28 at \$1 $\frac{1}{2}$ a day?

3. One and a half yards of cloth cost \$1 $\frac{1}{2}$. What was the price of a yard?
4. How many books at \$ $\frac{3}{4}$ apiece can be bought for \$3 $\frac{1}{4}$?
5. How many boxes, each containing $\frac{1}{2}$ of a bushel, can be filled from a barrel of apples (2 $\frac{1}{2}$ bushels)?
6. If it takes $\frac{3}{4}$ of a yard of cretonne to cover a box, how many boxes can be covered with 10 yards?
7. A bill for shoeing a horse was \$14. If each shoeing cost \$1 $\frac{1}{2}$, how many times was the horse shod?
8. At the rate of a mile in 2 $\frac{1}{2}$ minutes, it takes $\frac{1}{2}$ of an hour for a train to run from one station to another. How far apart are the stations?
9. A farmer exchanged 5 dozen eggs at \$ $\frac{3}{10}$ a dozen for flour at \$ $\frac{3}{4}$ a bag. How many bags of flour did he get?
10. It took 8 ten-yard rolls of ribbon for the diplomas of a graduating class. If $\frac{3}{4}$ of a yard was used for each diploma, how many pupils were in the class?

FINDING WHAT PART ONE NUMBER IS OF ANOTHER *Oral*

1. What part of a dozen oranges is 1 orange? 6 oranges? 4? 8? 3? 9? 2? 10?
2. What part of a score (20) is 1? 10? 5? 15? 4? 8? 12? 16? 2? 6? 14? 18?
3. What part of a score is 1 dozen? $\frac{1}{2}$ of a dozen? $\frac{1}{3}$ of a dozen? $\frac{2}{3}$ of a dozen? $\frac{1}{4}$ of a dozen? $\frac{3}{4}$ of a dozen? $\frac{1}{6}$ of a dozen? $\frac{5}{6}$ of a dozen?
4. Five girls made 24 pounds of candy for a country week fund. On six days they sold 1 pound, 2 pounds,

3 pounds, 4 pounds, 6 pounds, 8 pounds. What part did they sell each day?

5. Edgar earned \$20. He bought a hat for \$1, a pair of shoes for \$2, a reefer for \$5, and a suit with the rest of his money. What part of his money did each article cost?

6. A contractor calls 48 hours a week's work. What part of a week's work is 12 hours? 36 hours? 16 hours? 32 hours? 8 hours? 40 hours? 6 hours? 18 hours? 30 hours? 42 hours? 24 hours? 48 hours?

PROBLEMS

Written

1. In the month of September it rained 7 days and was cloudy 5 days. What part of the month was fair?

2. Lewis earns \$6 a week and his father earns \$20. Compare their wages.

3. Eugene puts in the bank 25 cents out of every dollar that he earns. What part of his money does he save? If his average earnings are a dollar a week, how much does he save in a year of 52 weeks?

4. A newsboy buys papers at 3 cents each and sells them at 5 cents each. How much does he gain? What part of the cost does he gain?

5. What part of the cost is gain when milk bought at 5 cents a quart is sold at 8 cents a quart?

6. Susan had 75 cents in her purse. She bought 6 handkerchiefs at the rate of 3 for a quarter. What part of her money did she spend?

7. Mr. Baxter bought a horse for \$200. He sold it for \$50 more than he paid. What part of the cost did he gain?

8. For collecting bills Howard received 10 cents out of every dollar collected. His pay was what part of the money collected?

9. At the rate of 10 cents on a dollar, what must be paid for collecting a bill of 40 dollars? At $12\frac{1}{2}$ cents?

10. What part of a barrel of kerosene containing 60 gallons is left after $\frac{3}{4}$ of it is sold to one customer and 5 gallons to another?

DRILL EXERCISE

Oral

1. Find (1) $\frac{1}{2}$ of:

2	4	6	8	1	3	5	7	9
---	---	---	---	---	---	---	---	---

(2) $\frac{1}{4}; \frac{3}{4}$ (5) $\frac{1}{5}; \frac{2}{5}; \frac{3}{5}; \frac{4}{5}$ (8) $\frac{1}{8}; \frac{3}{8}; \frac{5}{8}; \frac{7}{8}$
 (3) $\frac{1}{3}; \frac{2}{3}$ (6) $\frac{1}{6}; \frac{5}{6}$ (9) $\frac{1}{9}; \frac{2}{9}; \frac{4}{9}; \frac{5}{9}; \frac{7}{9}$
 (4) $\frac{1}{8}; \frac{3}{8}$ (7) $\frac{1}{12}; \frac{5}{12}; \frac{7}{12}; \frac{11}{12}$ (10) $\frac{1}{11}; \frac{2}{11}; \frac{3}{11}; \frac{5}{11}; \frac{7}{11}; \frac{10}{11}$

2. From each number in the row take each of the fractions.

3. Divide each number in the row by each of the fractions.

4. Make up simple problems based on the combinations in the above exercises.

FINDING THE WHOLE WHEN A PART IS GIVEN

Oral and Written

1. Nellie paid 15 cents for $\frac{3}{4}$ of a yard of cloth. What was the price per yard?

2. Ernest and Herbert bought a baseball. Ernest paid 20 cents. This was $\frac{2}{3}$ of the cost. How much did the ball cost? What part of the cost did Herbert pay? How much?

3. How long was the summer vacation if $\frac{3}{4}$ of it was 8 weeks?

4. Mrs. Wells paid 25 cents for thread. This was $\frac{5}{8}$ of what she paid for silk. How much did she pay for silk?

5. Ada is $\frac{2}{3}$ as old as her mother. Ada is 12 years old. How old is her mother?

6. A baseball team won 40 games. This was $\frac{5}{8}$ of the number played. How many games were played?

7. A load of wood cost 6 dollars. This was $\frac{3}{4}$ of the cost of a load of coal. How much did the coal cost?

8. After selling $\frac{3}{4}$ of a tub of butter, the grocer had 14 pounds left. How many pounds had he at first?

9. Ethel spelled 20 words correctly. She misspelled $\frac{1}{4}$ of the words given. How many words were given?

10. Mrs. Bradford bought $1\frac{1}{2}$ dozen, or $\frac{5}{2}$ dozen, buttons for 20 cents. What was the rate per dozen?

11. Roy has 24 marbles. This is $1\frac{1}{2}$, or $\frac{3}{2}$, times as many as Ralph has. How many has Ralph?

12. There are 85 boys in the fifth class. This is $1\frac{3}{4}$ times as many as in the sixth class. How many in the sixth class?

DRILL EXERCISE

Written

In the following examples solve the part in parenthesis first.

Thus, $\frac{3}{7} \times (\frac{3}{4} + \frac{1}{2})$

$$\frac{3}{4} + \frac{1}{2} = \frac{3}{4} + \frac{2}{4} = \frac{5}{4}$$

$$\frac{3}{7} \times \frac{5}{4} = \frac{15}{28} = 1\frac{1}{4}$$

Finding a fractional part of a number is called multiplying by a fraction.

14. $\frac{2}{3} \times 8$

$$\frac{1}{3} \text{ of } 8 = \frac{8}{3}; \quad \frac{2}{3} \text{ of } 8 = \frac{16}{3} = 5\frac{1}{3}.$$

15. $\frac{2}{3} \times 7$

16. $\frac{3}{8} \times 5$

17. $\frac{3}{8} \times 8$

18. $\frac{3}{8} \times 1\frac{1}{2}$

19. $\frac{3}{4} \times 9$

20. $\frac{3}{8} \times 3$

21. $\frac{3}{8} \times 4$

22. $\frac{2}{3} \times 8$

23. $\frac{4}{5} \times 6$

24. $\frac{1}{7} \times 8$

25. $\frac{3}{11} \times 9$

26. $\frac{3}{4} \times 9$

27. $\frac{5}{6} \times 7$

28. $\frac{3}{10} \times 7$

29. $\frac{5}{12} \times 5$

30. $\frac{5}{8} \times 7$

31. $\frac{3}{7} \times 6$

32. $\frac{5}{11} \times 9$

33. $\frac{7}{12} \times 11$

34. $\frac{8}{9} \times 4$

Written

35. $\frac{1}{2} \times 45$

36. $\frac{3}{8} \times 25$

37. $\frac{3}{8} \times 19$

38. $\frac{2}{7} \times 22$

39. $\frac{3}{4} \times 19$

40. $\frac{5}{8} \times 15$

41. $\frac{7}{9} \times 40$

42. $\frac{3}{8} \times 37$

43. $\frac{5}{6} \times 23$

44. $\frac{4}{7} \times 30$

45. $\frac{3}{10} \times 39$

46. $\frac{5}{12} \times 41$

47. $\frac{6}{7} \times 45$

48. $\frac{4}{9} \times 50$

49. $\frac{5}{8} \times 53$

50. $\frac{8}{9} \times 64$

51. $\frac{7}{8} \times 81$

52. $\frac{7}{12} \times 71$

53. $\frac{5}{7} \times 80$

54. $\frac{7}{10} \times 83$

MULTIPLYING A FRACTION BY A FRACTION

1. $\frac{2}{3} \text{ of } \frac{3}{\text{days}} = ?$

2. $\frac{3}{8} \text{ of } \frac{2}{7} = ?$

$$\frac{1}{3} \text{ of } \frac{3}{\text{days}} = \frac{1}{\text{day}}$$

$$\frac{1}{8} \text{ of } \frac{2}{7} = \frac{1}{28}$$

$$\frac{2}{3} \text{ of } \frac{3}{\text{days}} = \frac{2}{\text{days}}$$

$$\frac{3}{8} \text{ of } \frac{2}{7} = \frac{3}{28}$$

If in finding the product of $\frac{2}{3} \times \frac{2}{7}$, the numerators are multiplied together for a new numerator, and the denominators multiplied together for a new denominator, the same result is obtained as in the process just described.

(1) $\frac{2}{3} \times \frac{3}{7} = \frac{6}{21} = \frac{2}{7}$

(2) $\frac{2}{3} \times \frac{3}{7} = \frac{2}{7}$

9. What is the cost of $2\frac{1}{2}$ yards of cloth at $\frac{2}{3}$ of a dollar a yard and $1\frac{1}{2}$ yards at $1\frac{1}{2}$ dollars a yard?

10. Mrs. Sherman owed her grocer $\$1\frac{1}{2}$, $\$3\frac{2}{3}$, $\$2\frac{4}{5}$, and $\$1\frac{7}{10}$. She gave a $\$10$ -bill in payment. How much did the grocer return?

11. If a ticket to Denver costs $\$2$, how much ought a ticket to cost to a place $\frac{1}{2}$ as far away? To a place 3 times as far away? To a place $1\frac{1}{2}$ times as far away?

12. A stationer gained $\$1$ by selling a book for $\$1\frac{1}{2}$. Find the cost.

13. The rent of a house for 15 weeks was $\$41\frac{1}{2}$. What was the rent for 1 week?

14. At $\$1\frac{1}{2}$ per rod, what will $10\frac{1}{2}$ rods of fence cost?

15. The deposits made in a bank were $84\frac{3}{4}$ dollars, $62\frac{1}{2}$ dollars, $75\frac{3}{5}$ dollars. The withdrawals were $15\frac{6}{5}$ dollars, $9\frac{7}{10}$ dollars, and $67\frac{1}{4}$ dollars. How much was left in the bank?

16. How many sacks of potatoes at $\$1\frac{1}{4}$ a sack will pay for 15 yards of cloth at $\$2$ a yard?

17. A man owning $\frac{1}{4}$ of a mill sold $\frac{1}{2}$ of his share for $\$5000$. At that rate what was the whole mill worth?

18. If $\frac{7}{8}$ of a quart fills a bottle, how many bottles can be filled from $17\frac{1}{2}$ quarts of maple sirup?

19. An express train runs $\frac{3}{4}$ of a mile in $\frac{7}{8}$ of a minute. What is the rate a minute? How long does it take to run a mile?

20. A gang of men laid $\frac{1}{8}$ of a sewer in one day, $\frac{2}{10}$ the next day, and $\frac{1}{2}$ the third day. What part of the work was then done? What part remained to be done?

21. After selling $\frac{3}{4}$ of a barrel of oil, the grocer had 9 gallons left. How many gallons had he at first?

22. What is the sum of the ages of 5 children whose ages are, respectively, $6\frac{5}{12}$ years, $8\frac{7}{12}$ years, $10\frac{3}{4}$ years, $7\frac{1}{2}$ years, and $9\frac{1}{4}$ years? What is the average age?

23. A farmer can mow a piece of grain in 4 hours. His son can mow it in 6 hours. If both work together, what part of the piece can they mow in 1 hour?

24. A gardener planted 80 geraniums. 24 of them died. What part lived?

25. A plumber is paid $\$4\frac{1}{2}$ a day, and his helper $\frac{2}{3}$ as much. How much is paid to both?

DECIMALS

A *power* of a number is the product obtained by using that number as a factor a specified number of times. Thus, the second power of 10 is 10×10 , or 100; the third power of 10 is $10 \times 10 \times 10$, or 1000; and so on.

Fractions whose denominators are 10, 100, 1000, etc., as $\frac{7}{10}$, $\frac{7}{100}$, $\frac{7}{1000}$, that is, common fractions whose denominators are 10, or some power of 10, are *decimal fractions*.

When the denominators are expressed by a decimal point, as in .7, .07, .007, such fractions are called *decimals*.

The word "decimal" comes from the Latin word *decem*, which means ten.

When a decimal fraction is expressed as a decimal, there are as many places in the decimal as there are 0's in the denominator of the decimal fraction. Thus, $\frac{9}{10} = .9$; $\frac{9}{100} = .09$; $\frac{9}{1000} = .009$; $\frac{9}{10000} = .0009$; and so on.

58. How many decimal places are required to express tenths? To express hundredths? Thousandths? Ten-thousandths? Hundred-thousandths? Millionths?

59. Write the figure 6 so that it shall express tenths; hundredths; thousandths; ten-thousandths; hundred-thousandths; millionths.

60. Write in figures six hundred eight ten-thousandths.

Ten-thousandths shows that the last figure of the decimal stands in the fourth decimal place, so we write .0608.

61. Write in figures six hundred and eight ten-thousandths. The whole number is 600, the decimal .0008; so we write 600.0008.

Write in figures:

62. Seven and three hundredths.

63. Nine thousandths.

64. Two hundred eighty-six ten-thousandths.

65. Two hundred and eighty-six ten-thousandths.

66. Seven hundred fifty-two hundred-thousandths.

67. Thirty-six and eight hundred-thousandths.

68. Five hundred twenty-seven millionths.

69. Nine and three thousand forty-six millionths.

70. Seventeen and one hundred three ten-thousandths

71. Sixty and sixteen ten-thousandths.

72. Four and four thousandths.

73. Four hundred and four thousandths.

74. Four hundred four thousandths.

CHANGING DECIMALS TO COMMON FRACTIONS *Oral*

1. What is the denominator in .2? .7? .12? .08? .125? .015? .004?

2. Change .08 to a common fraction in its lowest terms.

$$.08 = \frac{8}{100} = \frac{2}{25}$$

3. Change .075 to a common fraction.

$$.075 = \frac{75}{1000} = \frac{3}{40}$$

4. Change $.33\frac{1}{3}$ to a common fraction.

$$(1) \quad .33\frac{1}{3} = \frac{33\frac{1}{3}}{100} = \frac{\frac{100}{3}}{100} = \frac{100}{3} \times \frac{1}{100} = \frac{1}{3}$$

$$(2) \quad .33\frac{1}{3} = \frac{33\frac{1}{3} \times 3}{100 \times 3} = \frac{100}{300} = \frac{1}{3}$$

To change a decimal to a common fraction, write the numerator over the denominator expressed in figures, and change to lowest terms.

Such expressions as .6, .375, .006, that is, decimals in which the numerator is a whole number, are *simple* or *pure decimals*.

Such expressions as $.33\frac{1}{3}$, $.37\frac{1}{2}$, $.14\frac{2}{7}$, that is, decimals in whose numerator there is a common fraction, are *complex decimals*.

Name the common fractions equivalent to:

5. .1 .2 .3 .4 .5 .6 .7 .8 .9

6. .10 .20 .30 .40 .50 .60 .70 .80 .90

Written

Change to common fractions in their lowest terms:

7. .02 8. .04 9. .06 10. .08

11. .12 12. .16 13. .24 14. .32

15. .36	16. .48	17. .64	18. .72
19. .25	20. .75	21. .35	22. .85
23. .125	24. .375	25. .625	26. .875
27. $.12\frac{1}{2}$	28. $.37\frac{1}{2}$	29. $.62\frac{1}{2}$	30. $.87\frac{1}{2}$
31. $.33\frac{1}{3}$	32. $.66\frac{2}{3}$	33. $.16\frac{2}{3}$	34. $.83\frac{1}{3}$

CHANGING COMMON FRACTIONS TO DECIMALS *Oral*

1. Change $\frac{2}{5}$ to a decimal.

$$\frac{2}{25} \times \frac{4}{4} = \frac{8}{100} = .08$$

Since the denominator of a decimal is 10 or some power of 10, we must change $\frac{2}{5}$ to a fraction whose denominator is 10, 100, 1000, etc. Multiplying both terms of $\frac{2}{5}$ by 4, we get $\frac{8}{20}$. Writing $\frac{8}{20}$ in decimal form, we get .08.

Give the decimal equivalent of:

- | | | | | |
|---------------------|--------------------|---------------------|--------------------|---------------------|
| 2. $\frac{1}{2}$ | 3. $\frac{1}{4}$ | 4. $\frac{3}{4}$ | 5. $\frac{1}{5}$ | 6. $\frac{2}{5}$ |
| 7. $\frac{3}{5}$ | 8. $\frac{1}{5}$ | 9. $\frac{1}{10}$ | 10. $\frac{3}{10}$ | 11. $\frac{7}{10}$ |
| 12. $\frac{9}{10}$ | 13. $\frac{1}{20}$ | 14. $\frac{11}{20}$ | 15. $\frac{1}{4}$ | 16. $\frac{4}{5}$ |
| 17. $\frac{13}{25}$ | 18. $\frac{1}{50}$ | 19. $\frac{3}{50}$ | 20. $\frac{1}{10}$ | 21. $\frac{43}{50}$ |
22. Compare: \$1 \$1. \$1.0 \$1.00 \$1.000
23. Compare: 5 5.0 5.00 5.000
24. Is this statement true?

$$8)\underline{5} = 8)\underline{5} = 8)\underline{5.0} = 8)\underline{5.00} = 8)\underline{5.000}$$

When the decimal equivalent is not readily seen, change a common fraction to a decimal by dividing the numerator by the denominator.

25. Change $\frac{3}{5}$ to a decimal. 26. Change $\frac{5}{8}$ to a decimal.

$$\begin{array}{r} 5 \overline{)3.0} \\ .6 \end{array}$$

$$\begin{array}{r} 8 \overline{)5.000} \\ .625 \end{array}$$

In both these examples we place a decimal point after the numerator, and annex as many 0's as may be necessary.

To change a common fraction to a decimal, divide the numerator by the denominator.

Change to decimals:

Written

27. $\frac{1}{8}$.	28. $\frac{3}{8}$	29. $\frac{7}{8}$	30. $\frac{1}{16}$	31. $\frac{3}{16}$
32. $\frac{5}{16}$	33. $\frac{1}{32}$	34. $\frac{1}{40}$	35. $\frac{3}{40}$	36. $\frac{1}{80}$

Since the denominator of a decimal is always 10 or some power of 10, the only common fractions that can be expressed as pure decimals are those whose denominators, when the fractions are in their lowest terms, contain only the factors 2 or 5.

37. Which of these fractions can be expressed as pure decimals?

$\frac{1}{2}$	$\frac{3}{8}$	$\frac{4}{4}$	$\frac{4}{6}$	$\frac{5}{6}$	$\frac{6}{7}$	$\frac{7}{8}$	$\frac{8}{9}$	$\frac{9}{10}$	$\frac{5}{12}$
$\frac{1}{14}$	$\frac{2}{15}$	$\frac{7}{16}$	$\frac{5}{18}$	$\frac{9}{20}$	$\frac{11}{24}$	$\frac{2}{25}$	$\frac{7}{36}$	$\frac{13}{40}$	$\frac{3}{50}$

38. Change $\frac{1}{8}$ to a decimal.

$$\frac{1}{8} = 3 \overline{)1.0}, \text{ or } 3 \overline{)1.00}, \text{ or } 3 \overline{)1.000}, \text{ and so on.}$$

$$\begin{array}{r} 3 \overline{)1.0} = 3 \overline{)1.0}, \text{ or } 3 \overline{)1.0} \\ \underline{.3\frac{1}{8}} \quad \underline{.3+} \end{array}$$

$$\begin{array}{r} 3 \overline{)1.00} = 3 \overline{)1.00}, \text{ or } 3 \overline{)1.00} \\ \underline{.33\frac{1}{8}} \quad \underline{.33+} \end{array}$$

$$\begin{array}{r} 3 \overline{)1.000} = 3 \overline{)1.000}, \text{ or } 3 \overline{)1.000} \\ \underline{.333\frac{1}{8}} \quad \underline{.333+} \end{array}$$

That is, there will always be a remainder. Show this either by writing the undivided remainder as a fraction, or by writing a + sign after the last quotient figure.

Change to decimals carrying out the division three decimal places:

- | | | | | |
|--------------------|--------------------|--------------------|--------------------|---------------------|
| 39. $\frac{2}{3}$ | 40. $\frac{1}{6}$ | 41. $\frac{5}{8}$ | 42. $\frac{1}{7}$ | 43. $\frac{3}{7}$ |
| 44. $\frac{5}{7}$ | 45. $\frac{1}{3}$ | 46. $\frac{4}{9}$ | 47. $\frac{2}{3}$ | 48. $\frac{1}{12}$ |
| 49. $\frac{5}{12}$ | 50. $\frac{7}{12}$ | 51. $\frac{1}{16}$ | 52. $\frac{3}{16}$ | 53. $\frac{11}{16}$ |

DECIMALS: ADDITION

Oral

Find the sum of:

- | | | | | |
|---|--|--|--|---|
| 1. $\begin{array}{r} .5 \\ .5 \\ \hline \end{array}$ | 2. $\begin{array}{r} .9 \\ .4 \\ \hline \end{array}$ | 3. $\begin{array}{r} 1.3 \\ .7 \\ \hline \end{array}$ | 4. $\begin{array}{r} 2.4 \\ .8 \\ \hline \end{array}$ | 5. $\begin{array}{r} 2.5 \\ 1.5 \\ \hline \end{array}$ |
| 6. $\begin{array}{r} .5 \\ .25 \\ \hline \end{array}$ | 7. $\begin{array}{r} .25 \\ .75 \\ \hline \end{array}$ | 8. $\begin{array}{r} 1.5 \\ 2.5 \\ \hline \end{array}$ | 9. $\begin{array}{r} 2.25 \\ 3.25 \\ \hline \end{array}$ | 10. $\begin{array}{r} 1.58 \\ .3 \\ \hline \end{array}$ |

11. Mrs. Marston paid .3 of a dollar for sugar and .5 of a dollar for tea. What part of a dollar did she pay for both?

12. A family used .25 of a ton of coal in one month and .5 of a ton the next month. How much in both months?

13. Two tenths of a garden is given to roses, .3 to dahlias, and .25 to asters. What part of the garden is given to flowers?

14. Stella is 8.5 years old and Helen is 7.5 years old. What is the sum of their ages?

15. In canning berries, Mrs. Libby used 7.5 pounds of sugar and .25 of a pound of spice. What did both weigh?

WRITTEN EXERCISE

1. Add .5, .04, .785, .03, .018, and .07.

.5

.04

.785

.03

.018

.07

In arranging decimals in columns, that is, in writing them so that tenths are in one column, hundredths in another, and so on, we are really changing them to a common denominator.

Find the sum of :

2. .8, .64, .78, .8

3. 1.2, 3.7, .5, 1.9

4. 8.375, 5.06, 9.008, 7.064

5. 160.5, 128.7, 64.03, 98.01

6. 37.55, 64.98, 121.06, 112.003

7. .003, .0104, .08005, .0004

8. 65, 9.008, 13.05, 12.004

9. 100.56, 84.07, 98.005, 86.002

10. 1012.5, 648.03, 954.002, 671.08

11. .6, .06, .006, .0006, .00006

12. 4 tenths; 75 thousandths; 3 hundredths; 12 ten-thousandths; 65 thousandths.

13. Sixty-four ten-thousandths; one hundred four thousandths; three tenths; eight ten-thousandths.

14. One hundred ten thousandths; twenty-six thousandths; six hundred forty-seven thousandths; eighty-five hundred-thousandths.

15. Two hundred ten thousandths; two ten-thousandths; two hundred ten thousand.

16. Seven hundred and seven tenths; one hundred four and sixty-five thousandths; seventy-five and five hundredths; forty and sixty-five ten-thousandths.

PROBLEMS

Written

1. How many tons of coal in three loads weighing, respectively, 1.75 tons, 1.875 tons, and 2.5 tons?
2. The four sides of a lot measure 20.8 yards, 27.5 yards, 26.25 yards, and 21.75 yards. What length of fence will inclose it?
3. A bicycle cyclometer registered the following distances on five successive days: 12.9 miles, 17.25 miles, 14.8 miles, 20.65 miles, and 16.5 miles. What was the entire distance traveled?
4. A farmer purchased five adjoining fields whose areas were 3.675 acres, .85 of an acre, 1.005 acres, 4.012 acres, and 7.2 acres. How many acres in all?
5. Mr. Simpson drove his automobile 46.2 miles, 38.5 miles, and 40.75 miles. His speedometer read 130.3 miles at the start. What did it read at the finish?

DECIMALS: SUBTRACTION

Oral

Find differences:

1. $\begin{array}{r} 1.8 \\ .8 \\ \hline \end{array}$	2. $\begin{array}{r} 1.2 \\ .5 \\ \hline \end{array}$	3. $\begin{array}{r} .50 \\ .25 \\ \hline \end{array}$	4. $\begin{array}{r} 8.3 \\ 2.1 \\ \hline \end{array}$	5. $\begin{array}{r} .07 \\ .02 \\ \hline \end{array}$
6. $\begin{array}{r} 5.75 \\ .5 \\ \hline \end{array}$	7. $\begin{array}{r} 2.75 \\ .25 \\ \hline \end{array}$	8. $\begin{array}{r} 2.50 \\ .25 \\ \hline \end{array}$	9. $\begin{array}{r} 2.3 \\ .5 \\ \hline \end{array}$	10. $\begin{array}{r} 2.2 \\ 1.5 \\ \hline \end{array}$

11. From 1 take .1; .2; .8; .9.
12. From 1 take .5; .25; .75.
13. From 2 take 1.5; 1.25; 1.75.

- ✕ 14. When you have completed .6 of your journey, what part remains to be traveled?
- ✓ 15. If you spend .85 of your money, what part have you left?
- ✕ 16. Mrs. Joslin bought a yard of silk and used .75 of it for trimming. What part of a yard had she left?
- ✕ 17. Four tenths of a bushel of apples decayed. What part was good?
- ✕ 18. Dora was given .75 of a dollar. She spent .2 of a dollar for a belt and .1 of a dollar for ice cream. What part of a dollar had she then?

WRITTEN EXERCISE

1. From .6 take .35; .035; .0035.
2. From .08 take .04; .004; .0004.
3. From .004 take .003; .0003.
4. From 6.75 take .305.
5. Take .03 from 30.1.
6. From .04 take .018.
7. Take 7.2 from 26.01.
8. From .9 take .36.
9. Take 3.05 from 10.7.
10. From 8.06 take 6.08.
11. Take .015 from 6.4.
12. From .764 take .0647.
13. Take .0085 from 3.7.
14. Subtract two tenths from two.
15. What is the difference between ten and one tenth, and one and one tenth?
16. What is left when six and seven hundredths is taken from eight and twenty-four thousandths?
17. Find the difference between seventy-six and five hundredths, and fifty-nine and eight thousandths.
18. From five take seven thousandths.

19. Take thirteen hundredths from two hundred one thousandths.

20. From one and one hundred sixty-two ten-thousandths take one hundred twenty-two thousandths.

21. From three and twenty-five thousandths take forty-nine hundredths.

PROBLEMS

Written

1. A owns .42 of a vessel, and B the remainder. What part does B own?

2. What remains, if from .8 of a bushel of corn .375 of a bushel is taken?

3. If Harvey loses .625 of his kite string, what part has he left?

4. If Joseph spends .125 of his money for a ball, .4 for a knife, and .25 for a bat, what part of his money has he left?

5. A French franc piece is worth nineteen and three tenths cents. How much less than one fifth of a United States dollar?

6. Which is the greater quantity, $\frac{3}{4}$ of a pound of butter or .875 of a pound of butter? How much greater?

7. A man left .5 of his property to his wife, .225 to his son, and the rest to his daughter. What was the daughter's share?

8. A man does a piece of work in five days. What part of the work does he do the last day, if the work of the first four days is as follows: .25, .15, .165, .2?

9. A received $\frac{1}{2}$ of an estate, and B .45 of the estate. Which received the greater share? By how much?

DECIMALS: MULTIPLICATION

Oral

Give products:

1. $\begin{array}{r} .5 \\ \underline{2} \end{array}$	2. $\begin{array}{r} 12 \\ \underline{.5} \end{array}$	3. $\begin{array}{r} 8 \\ \underline{.4} \end{array}$	4. $\begin{array}{r} .7 \\ \underline{5} \end{array}$	5. $\begin{array}{r} .3 \\ \underline{2} \end{array}$
6. $\begin{array}{r} .5 \\ \underline{6} \end{array}$	7. $\begin{array}{r} .25 \\ \underline{.4} \end{array}$	8. $\begin{array}{r} .75 \\ \underline{2} \end{array}$	9. $\begin{array}{r} 2.2 \\ \underline{6} \end{array}$	10. $\begin{array}{r} 1.25 \\ \underline{5} \end{array}$

11. Multiply by 3: .2 .02 .002

12. Multiply by 2: .8 .06 .007

13. Multiply by 5: .4 .08 .006

14. Multiply by 4: .5 .05 .005

15. A newsboy sold .9 of his 50 papers. How many?

16. Twenty-five hundredths of a flock of 80 sheep were sold. How many?

17. A suit cost \$15 and a hat .2 as much. What did the hat cost?

18. How much is .4 of \$600?

19. When Mr. Spaulding has used .75 of his 12 tons of coal, how many tons remain?

20. Multiply .7 by .3.

$$\frac{7}{10} \times \frac{3}{10} = \frac{21}{100} = .21$$

$$\begin{array}{r} .7 \\ \underline{.3} \\ .21 \end{array}$$

Change the decimals to common fractions and multiply. $\frac{7}{10} \times \frac{3}{10} = \frac{21}{100}$. Expressing $\frac{21}{100}$ in decimal form, we get .21. In multiplying .7 by .3, it is evident that,

since the denominators are 10 and 10, the denominator of the product must be 10×10 , or 100. A decimal whose denominator is 100 occupies two decimal places, which is the sum of the decimal places in the multiplicand (.7) and the multiplier (.3).

21. Multiply .07 by .3.

$$\begin{array}{r} \frac{7}{100} \times \frac{3}{10} = \frac{21}{1000} = .021 \\ \begin{array}{r} .07 \\ \times .3 \\ \hline .021 \end{array} \end{array}$$

The product of the denominators is 1000. A decimal whose denominator is 1000 occupies three decimal places, which is the sum of the decimal places in the multiplicand (.07) and the multiplier (.3).

To multiply decimals, multiply as in whole numbers and point off in the product as many decimal places as there are decimal places in both multiplicand and multiplier.

Note that the "pointing off" is simply the multiplying together of the denominators.

22. Without multiplying, tell how many decimal places in the product of:

$.8 \times 4$

$.03 \times .6$

$.004 \times .2$

$.005 \times .07$

$7 \times .6$

$.4 \times .09$

$.6 \times .004$

$.03 \times .009$

Written

Solve:

23. $.4 \times 12$

24. $8 \times .15$



25. 1.08×5

26. $.64 \times .25$

27. 6.25×14

28. $.35 \times .12$

29. 15.6×2.2

30. 3.02×1.06

31. $8.8 \times .08$

32. 3.4×2.5

33. $3.6 \times .005$

34. $.375 \times .44$

35. 37.2×1.05

36. $.075 \times 24$

37. 1.8×2.25

38. 8.07×1.6

39. $62.5 \times .32$

40. 60.2×4.9

41. $.44 \times .265$

42. $.015 \times 144$

43. $87.5 \times .06$

44. $4.26 \times .62$

45. $3.125 \times .8$

46. $124 \times .75$

47. $.025 \times 1.24$

48. $6.6 \times .031$

49. 12.8×4.2

50. $123 \times .375$

51. $4.8 \times .085$

52. 16.5×4.82

MULTIPLYING BY 10, 100, 1000

Oral

1. Move the decimal point in \$2.000 one place to the right. What number have you now? How does \$20.00 compare with \$2.000? By what have you multiplied \$2.000?

2. Move the decimal point in \$2.000 two places to the right. What have you done to \$2.000?

3. What is the result of moving the decimal point in \$2.000 three places to the right? What have you done to \$2.000?

4. Multiply (1) by 10; (2) by 100; (3) by 1000:

256 34.7 7.28 .175 .0306 .0008

5. One lot contained .755 of an acre, and another lot 10 times as much. What was the area of the second lot?

6. There are 272.25 square feet in a square rod. How many in 100 square rods?

7. At \$2.75 a yard, how much will a merchant pay for 1000 yards of silk?

MULTIPLYING BY .1, .01, .001

Multiply 444.4 by .1; by .01; by .001.

To multiply a number by .1 is to find one tenth of it.

1. In multiplying by .1, how many places, and in what direction, is the decimal point moved?

2. Tell how to multiply by .01. By .001.

3. Multiply (1) by .1; (2) by .01; (3) by .001:

1247 800 1.2 4.03 .542 .08

Solve :

- | | | |
|------------------------|-------------------------|-------------------------|
| 4. 10×24.6 | 5. $1000 \times .35$ | 6. $100 \times .08$ |
| 7. $.01 \times 57.2$ | 8. $.001 \times 16.07$ | 9. $.1 \times 3.75$ |
| 10. $.1 \times .004$ | 11. $.01 \times .012$ | 12. 10×1.05 |
| 13. $100 \times .016$ | 14. 1000×1.035 | 15. $.01 \times .0007$ |
| 16. $.001 \times 1.44$ | 17. 10×5.27 | 18. $.001 \times 30.75$ |

19. Find by groups:

.1 of 5280 ft.	320 rd.	16.5 ft.	5.5 ft.	3 ft.	12 in.
.01 of 5280 ft.	320 rd.	16.5 ft.	5.5 ft.	3 ft.	12 in.
.001 of 5280 ft.	320 rd.	16.5 ft.	5.5 ft.	3 ft.	12 in.

PROBLEMS

Written

1. ~~X~~ Forty-five hundredths of the 160 acres in Mr. Cheever's farm is under cultivation. How many acres?
2. ~~X~~ At .64 of a dollar a bushel, how much will 12.5 bushels of oats cost?
3. ~~X~~ A rod is 16.5 feet. How many feet in 4.8 rods?
4. ~~X~~ There are 5280 feet in a mile. How many feet in .375 of a mile?
5. ~~X~~ How much will .75 of a bushel of apples cost at .8 of a dollar a bushel?
6. ~~X~~ At \$0.08 $\frac{1}{4}$ a foot, what will it cost to fence a four-sided field, 120 feet on a side?
7. At different times a man bought .8 of an acre of land, .375 of an acre, 2.25 acres, and 1.5 acres. At \$54 per acre, how much did it all cost?
8. A farmer has two fields, one containing 12.75 acres and the other .6 as many acres. How many acres in the second field? How many acres in both fields?

9. Mr. Bean's farm contains 240 acres. If he raises hay on $.12\frac{1}{2}$ of it, and harvests 1.5 tons to the acre, how many tons does he get?

10. Two men each owned .8 of an acre of land. One sold .375 of an acre. What part of an acre had he left? The other sold .375 of his lot. What part of an acre had he left?

DECIMALS: DIVISION

Written

Test these divisions:

$$\begin{array}{lllll} 1. \quad 5 \overline{) \$0.35} & 2. \quad 5 \overline{) \$0.035} & 3. \quad 3 \overline{) .6} & 4. \quad 3 \overline{) .06} & 5. \quad 3 \overline{) .006} \\ & \$0.07 & .2 & .02 & .002 \end{array}$$

In dividing a decimal by a whole number, the decimal point in the quotient stands in the same column as the decimal point in the dividend.

The first step in division of decimals is to write the decimal point in the quotient.

Divide, and test:

$$\begin{array}{llll} 6. \quad 2 \overline{) .8} & 7. \quad 2 \overline{) .24} & 8. \quad 2 \overline{) .024} & 9. \quad 2 \overline{) .008} \\ 10. \quad 3 \overline{) .9} & 11. \quad 3 \overline{) .15} & 12. \quad 3 \overline{) .027} & 13. \quad 3 \overline{) .009} \\ 14. \quad 6 \overline{) .6} & 15. \quad 6 \overline{) .36} & 16. \quad 6 \overline{) .036} & 17. \quad 6 \overline{) .006} \\ 18. \quad 5 \overline{) .5} & 19. \quad 5 \overline{) .15} & 20. \quad 5 \overline{) .015} & 21. \quad 5 \overline{) .005} \end{array}$$

$$22. \text{ Divide .1 by 5. } 5 \overline{) .1} = 5 \overline{) .10}$$

Divide, and test:

$$\begin{array}{llll} 23. \quad 5 \overline{) .2} & 24. \quad 5 \overline{) .02} & 25. \quad 5 \overline{) .002} & 26. \quad 5 \overline{) .012} \\ 27. \quad 4 \overline{) .2} & 28. \quad 4 \overline{) .02} & 29. \quad 4 \overline{) .002} & 30. \quad 4 \overline{) .018} \\ 31. \quad 6 \overline{) .3} & 32. \quad 6 \overline{) .03} & 33. \quad 6 \overline{) .003} & 34. \quad 6 \overline{) .015} \\ 35. \quad 8 \overline{) .4} & 36. \quad 8 \overline{) .04} & 37. \quad 8 \overline{) .004} & 38. \quad 8 \overline{) .012} \\ 39. \quad 8 \overline{) .1} & 40. \quad 4 \overline{) .03} & 41. \quad 4 \overline{) .003} & 42. \quad 4 \overline{) .034} \end{array}$$

43. .012 by 3 44. .56 by 7 45. .92 by 8
 46. .84 by 6 47. .3675 by 5 48. .873 by 9
 49. .1272 by 12 50. .728 by 7 51. .091 by 13
 52. .016 by 5 53. .315 by 15 54. .64 by 16
 55. .28 by 35 56. .0108 by 12 57. .3311 by 11
 58. 9.31 by 7 59. 17.28 by 12 60. 2.75 by 25
 61. 4.32 by 36 62. 42.84 by 42 63. 17.1 by 57
 64. 771.2 by 64 65. 1.98 by 18 66. 12.376 by 34
 67. 10.08 by 72 68. 19.95 by 19 69. 1.552 by 97
 70. 97.44 by 40 71. 438.9 by 21 72. .0774 by 86
 73. 6.6 by 75 74. 378.2 by 61 75. 1.394 by 17
 76. Divide .24 by .3 $.3 \overline{) .24} = 3 \overline{) 2.4}$

When there is a decimal in the divisor, change the divisor to a whole number by multiplying both divisor and dividend by 10, 100, 1000, etc. Thus, change $.3 \overline{) .24}$ to $3 \overline{) 2.4}$ by multiplying the divisor .3 by 10, and the dividend .24 by 10.

What is done in each of these cases to make the divisor a whole number?

77. $.2 \overline{) 1.6} = 2 \overline{) 16}$ 78. $.03 \overline{) .015} = 3 \overline{) 1.5}$
 79. $.06 \overline{) .42} = 6 \overline{) 42}$ 80. $.7 \overline{) 28} = 7 \overline{) 280}$
 81. $.04 \overline{) 1.28} = 4 \overline{) 128}$ 82. $.8 \overline{) .024} = 8 \overline{) .24}$
 83. $.02 \overline{) .0012} = 2 \overline{) .12}$ 84. $.005 \overline{) .35} = 5 \overline{) 350}$

Divide, first making the divisor a whole number:

85. $.7 \overline{) 8.4}$ 86. $.9 \overline{) .081}$ 87. $.04 \overline{) .036}$
 88. $.8 \overline{) .56}$ 89. $.2 \overline{) .72}$ 90. $.2 \overline{) 7.2}$
 91. $.6 \overline{) 72}$ 92. $.2 \overline{) .072}$ 93. $.08 \overline{) 1.08}$

94. $.07 \overline{)0.0014}$	95. $.06 \overline{)16.2}$	96. $.09 \overline{)135}$
97. $.9 \overline{).063}$	98. $.009 \overline{).054}$	99. $.09 \overline{)81.}$
100. $.09 \overline{)10.8}$	101. $1.2 \overline{)1.4}$	102. $.12 \overline{)14.4}$
103. $.12 \overline{).0144}$	104. $.012 \overline{)1.44}$	105. $.18 \overline{)17.28}$
106. $.27 \overline{)1.728}$	107. $3.6 \overline{)17.28}$	108. $.054 \overline{)1728}$

Solve :

109. $.625 \div 25$ ✓ 110. $9.36 \div .6$ ✓ 111. $17.28 \div .12$
 112. $64.68 \div 8.8$ ✓ 113. $445.2 \div .42$ ✓ 114. $12.72 \div .08$
 115. $.66 \div 120$ ✓ 116. $60 \div .625$ ✓ 117. $.012 \div .15$
 118. $300 \div .75$ ✓ 119. $19.68 \div .802$ ✓ 120. $14.4 \div .006$
 121. $768.8 \div .31$ 122. $.0012 \div .24$ ✓ 123. $8.04 \div 1.05$
 124. $24.98 \div .1$ 125. $37.64 \div .01$ ✓ 126. $5.32 \div .01$
 127. $.693 \div 4.5$ 128. $15.912 \div .52$ ✓ 129. $465 \div 3.75$
 130. $513.9 \div 4$ 131. $725 \div .025$ ✓ 132. $.2727 \div 3.03$
 133. $315 \div 2.52$ 134. $.2544 \div .01$ ✓ 135. $2400 \div 9.6$

PROBLEMS

Written

1. A field containing 7.2 acres was cut up into lots of .4 of an acre each. How many lots?
2. In 6 days a grocer sold 21.6 tubs of butter. What was the average quantity sold a day?
3. A pile of books is 33.75 inches high. If each book is .75 of an inch thick, how many books in the pile?
4. The distance between two places is 15.75 miles. How long will it take a railroad train running at the rate of .45 of a mile a minute to make the trip?
5. How many barrels of 2.5 bushels each must Mr. Davis buy to barrel 80 bushels of apples?

6. What is the average speed per hour of an automobile which goes 117.81 miles in 6.3 hours?

7. One hundred sixty-five bushels of potatoes were put up in bags of 1.5 bushels each. How many bags were used?

8. A bushel of grain occupies 1.25 cubic feet. How many bushels can be put into a bin whose capacity is 17.5 cubic feet?

9. A wheel of a wagon is 16.5 feet in circumference. How many revolutions will it make in going 1 mile (5280 ft.)?

10. An automobile speedometer registered 184.6 miles at the beginning of a trip, and 324.1 miles at the end. The trip was made in 6.2 hours. What was the distance traveled per hour?

DIVIDING BY 10, 100, 1000

Oral

$$333 \div 10 = 33.3$$

$$333 \div 100 = 3.33$$

$$333 \div 1000 = .333$$

1. Tell how to divide a number by 10. By 100. By 1000.

Solve:

2. $10 \div 10$

3. $2.5 \div 10$

4. $76.5 \div 100$

5. $37.5 \div 1000$

6. $273 \div 100$

7. $.002 \div 10$

8. $24.64 \div 10$

9. $10.01 \div 10$

10. $4.03 \div 10$

11. $24 \div 100$

12. $374.2 \div 1000$

13. $.5 \div 10$

14. $12.5 \div 10$

15. $.4 \div 100$

16. $3.7 \div 100$

17. Ten acres of land were sold for \$225. What was the rate per acre?

18. A railroad company carried 1000 people on an excursion for \$750. How much did each person pay?

19. What was the cost of a ton of coal if 100 tons cost \$565?

REVIEW EXERCISE

Written

1. Write in figures, five hundred five thousandths.
2. Write in figures, five hundred and five thousandths.
3. Write in words, 142.025.
4. Write in words, .0106.
5. What is the denominator in .8? .036? .04? .3786?
6. How many decimal places in $\frac{2}{10}$ when written as a decimal? $\frac{2}{100}$? $\frac{741}{1000}$? $\frac{7}{1000}$?
7. Express as decimals: $\frac{2}{5}$ $\frac{2}{10}$ $\frac{2}{20}$ $\frac{2}{25}$ $\frac{2}{50}$
8. Express as common fractions in their lowest terms:
.5 .50 .70 .06 .85 $.1\frac{1}{2}$ $.2\frac{1}{2}$
9. Find decimally the sum of $\frac{1}{4}$ and $\frac{1}{8}$.
10. What is the figure in the third decimal place when $\frac{1}{4}$ is expressed as a decimal?
11. What is the quotient of $4 \div .4$? Of $.4 \div 4$?
12. I have \$5. What is .2 of it? .5?
13. \$5 is .2 of my money. How much have I?
14. If 4 dozen oranges cost .8 of a dollar, what will 12 dozen cost?
15. If a peck of potatoes costs .4 of a dollar, what will a bushel cost?
16. Three caps cost .6 of a dollar. How many can be bought for a dollar?
17. $.2 \times .3 \times 1 = ?$

18. $.2 \times .3 \times 1 \times 0 = ?$

19. If you receive .05 of what you collect, how much will you receive for collecting \$32?

20. What part of 27 is 9? Express the answer decimally.

21. Howard and Fred each earned .8 of a dollar. Howard spent .5 of a dollar at the circus. How much had he left? Fred spent .5 of his money in car rides. How much had he left?

Solve by groups:

- | | | | |
|------------------|-----------------|------------------|------------------|
| 22. $1 + .1$ | 23. $.1 + .1$ | 24. $10 + .1$ | 25. $1 + .01$ |
| $1 - .1$ | $.1 - .1$ | $10 - .1$ | $1 - .01$ |
| $1 \times .1$ | $1 \times .1$ | $10 \times .1$ | $1 \times .01$ |
| $1 \div .1$ | $.1 \div .1$ | $10 \div .1$ | $1 \div .01$ |
| 26. $1.2 + 1.2$ | 27. $16 + .16$ | 28. $.15 + .15$ | 29. $1.2 + .04$ |
| $1.2 - 1.2$ | $16 - .16$ | $.15 - .15$ | $1.2 - .04$ |
| 1.2×1.2 | $16 \times .16$ | $.15 \times .15$ | $1.2 \times .04$ |
| $1.2 \div 1.2$ | $16 \div .16$ | $.15 \div .15$ | $1.2 \div .04$ |
| 30. $2.4 + 2$ | 31. $6.3 + .3$ | 32. $4 + .05$ | 33. $.24 + .03$ |
| $2.4 - 2$ | $6.3 - .3$ | $4 - .05$ | $.24 - .03$ |
| 2.4×2 | $6.3 \times .3$ | $4 \times .05$ | $.24 \times .03$ |
| $2.4 \div 2$ | $6.3 \div .3$ | $4 \div .05$ | $.24 \div .03$ |

34. George earned \$2 one day and \$.2 the next. How much did he earn in both days?

35. Richard had \$2 and spent \$.2. How much had he left?

36. Robert had \$2 and bought neckties at \$.2 each. How many did he buy?

37. Frank bought 2 baseballs at \$.2 each. How much did he pay for them?

38. Mr. Atkinson had 5 acres of land. How much had he after buying .5 of an acre from his neighbor?

39. Mr. Blake had 5 acres and sold .5 of an acre. How much had he left?

40. Mr. Sayles sold .5 of a pasture containing 5 acres. How many acres did he sell?

41. A field containing 5 acres was cut up into lots of .5 of an acre each. How many lots?

LINEAR MEASURE

Oral

A straight line is the shortest distance between two points.

A line has one dimension—length.

Linear or Long Measure is used in measuring lengths or distances.

1. Learn:

TABLE OF LINEAR MEASURE

12 inches (in.)	= 1 foot (ft.)
3 feet	= 1 yard (yd.)
5½ yards	} = 1 rod (rd.)
or	
16½ feet	
320 rods	= 1 mile (mi.)

2. Fill the blanks:

1 mile = — rods = — yards = — feet = — inches

The sign " is frequently used for inches, and the sign ' for feet. Thus, 2' 6" means 2 feet 6 inches.

3. How many inches in 1 ft. 3 in.? 2 ft. 8 in.? 3 ft. 4 in.? 4 ft. 2 in.? 5 ft.? 6 ft. 6 in.? $2\frac{3}{4}$ ft.? $1\frac{1}{2}$ ft.?
4. How many inches in $\frac{1}{2}$ yd.? $\frac{1}{4}$ yd.? $\frac{3}{4}$ yd.? $\frac{1}{8}$ yd.?
5. How many feet in $1\frac{1}{2}$ yd.? $2\frac{3}{4}$ yd.?
6. Express: 14 yards as feet; 14 feet as yards.
7. What part of a yard is 1 ft.? 2 ft.? $1\frac{1}{2}$ ft.? 1 ft. 8 in.? 1 ft. 8 in.? 2 ft. 6 in.?
8. Leon is 52 inches tall. How many feet?
9. How tall are you?
10. What is the height of the tallest boy in the room? Of the shortest boy? What is the difference in their heights?
11. How many inches from the floor is your desk? Your chair?
12. Make other measurements about the schoolroom.

Express as parts of a mile:

- | | | | | |
|-------------|--------|--------|--------|--------|
| 13. 160 rd. | 80 rd. | 40 rd. | 20 rd. | 10 rd. |
| 14. 32 rd. | 16 rd. | 8 rd. | 4 rd. | 2 rd. |

Change to rods:

- | | | | | |
|------------------------|--------------------|--------------------|--------------------|--------------------|
| 15. $\frac{1}{2}$ mi. | $\frac{1}{4}$ mi. | $\frac{3}{4}$ mi. | $\frac{5}{8}$ mi. | $\frac{3}{10}$ mi. |
| 16. $\frac{3}{16}$ mi. | $\frac{2}{20}$ mi. | $\frac{5}{32}$ mi. | $\frac{7}{40}$ mi. | $\frac{9}{80}$ mi. |

PROBLEMS

Written

1. How many telegraph poles, placed 10 rods apart, are required to string a mile of telegraph wire?
2. How much will the wire in problem 1 cost at $\frac{1}{2}$ of a cent a foot?

3. A gymnasium running track measures 16 laps to a mile. How many rods to a lap? What part of a mile does Victor run in making 5 circuits?
4. How many rods around a rectangular field 100 rods long and 60 rods wide? What name is given to this number of rods?
5. David runs a 100-yard dash in 12 seconds. How many feet a second?
6. A hand is 4 inches. A horse $14\frac{1}{2}$ hands high is how many feet high?
7. A passenger car is 70 feet long. How many yards? How many rods?
8. Blanche lives 3168 feet from the schoolhouse, Ruby 200 rods, and Alice $\frac{1}{2}$ of a mile. Who has the longest walk? Who has the shortest walk?

SQUARE OR SURFACE MEASURE

A surface has two dimensions — length and width.

Square measure is used in measuring surfaces.

1. Learn :

TABLE OF SQUARE OR SURFACE MEASURE

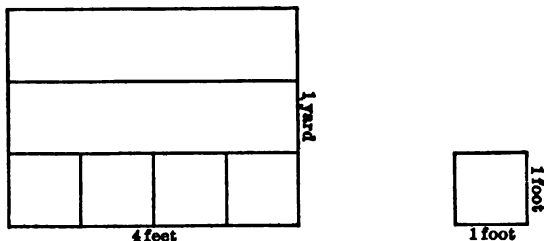
144 square inches (sq. in.)	= 1 square foot (sq. ft.)
9 square feet	= 1 square yard (sq. yd.)
$30\frac{1}{4}$ square yards	= 1 square rod (sq. rd.)
or	
$272\frac{1}{4}$ square feet	= 1 acre (A.)
160 square rods	
640 acres	= 1 square mile (sq. mi.)

3. Fill the blanks:

1 A. = — sq. rd. = — sq. yd. = — sq. ft.

The area of a surface is the number of square units it contains.

3. How many square feet in a rectangle 4 feet long and 1 yard wide?



4 feet by 1 yard = 4 feet by 3 feet.

What is the unit of measurement? How many of these units in 1 row? In all the rows?

Short method: $3 \times 4 = 12$.

Think first of the unit of measurement.

The area of a rectangle can always be found by multiplying together its length and its width, when both are expressed in the same unit of measurement (inches, feet, yards, etc.).

NOTE. While, for convenience, we say that we multiply the two dimensions together, it must be noted that this is not strictly true. We cannot say that 3 feet times 4 feet equals 12 square feet any more than we can say that 3 eggs times 4 eggs equals 12 square eggs, since the multiplier is always an abstract number and simply tells the number of times a quantity is taken. What we mean is that, since the unit of measurement is 1 square foot, we have in one row 4 of these units, or 4 square feet; in 3 rows we have 3 times 4 square feet, or 12 square feet.

PROBLEMS

Oral

1. How many square inches in a rectangle 15" by 6" ?
2. How many square yards in a piece of canvas 12 yards long and $3\frac{1}{2}$ yards wide ?
3. What is the area of a surface 3 yards long and 6 feet wide ?
4. How long is a garden 4 yards wide, if it contains 60 square yards ?
5. A square flower plot contains 36 square feet. What are its dimensions ?
6. How many square feet in the top of a desk 4 feet long and $2\frac{1}{2}$ feet wide ?
7. What is the area in square yards of a floor 12 feet long and 6 feet wide ?
- ✕ 8. A square garden contains 81 square feet. How many square yards ?
- ✕ 9. How many acres in a lot of land 32 rods long and 5 rods wide ?
- + 10. What part of an acre is a lot of land 8 rods by 2 rods ? A lot 10 rods by 10 rods ?
- + 11. A piece of paper covers 96 square inches. It is 12 inches long. How wide is it ?
- + 12. A rectangle 12 feet long is twice as long as it is wide. Find its area.
- + 13. How many rods of fence will inclose a lot 8 rods long and 6 rods wide ?
- ✓ 14. What is the perimeter of a lot 8 rods square ? The area ?

NOTE. Much attention should be given to oral analysis of problems by pupils. This requires concentration of attention and a clear conception of the conditions stated. No set form of expression should be required, but the correct use of "if," "since," and "therefore" should be carefully taught. Pupils should be encouraged to be on the alert for short methods of solution, and to solve orally as many of the problems as possible.

Find the areas of rectangles of these dimensions:

LENGTH		WIDTH		LENGTH		WIDTH	
15.	16 in.	12½ in.		16.	1 ft. 6 in.	1 ft. 4 in.	
17.	36 ft.	9 yd.		18.	3½ yd.	2½ ft.	
19.	3½ ft.	30 in.		20.	12½ ft.	12½ ft.	
21.	15 yd.	2 ft. 8 in.		22.	15 ft.	7 ft. 4 in.	
23.	5 ft. 8 in.	2½ ft.		24.	12 rd.	66 ft.	

25. Find the perimeters of the rectangles.

26. What is the area of the top of a table 4 feet 8 inches long and 2 feet 6 inches wide?

27. A rug is 144 inches long. Its width is two thirds of its length. How many square yards does it cover?

28. A lot of land containing 60 square rods cost \$1272. How much would an acre cost at this rate?

29. How many acres in a lot of land 80 rods long and 24 rods wide?

Study these solutions:

$$(1) 80 \times 24 = 1920, \text{ sq. rd. in lot.}$$

$$1920 \div 160 = 12, \text{ A. in lot.}$$

$$12$$

$$(2) \frac{80 \times 24}{160} = 12, \text{ A. in lot.}$$

$$2$$

Note that in the mechanical work we treat the dimensions as abstract numbers.

Find the area in acres of lots of these dimensions:

LENGTH	WIDTH	LENGTH	WIDTH
30. 25 rd.	18 rd.	31. 32 rd.	25 rd.
32. 48 rd.	45 rd.	33. 36 rd.	20 rd.
34. $12\frac{1}{2}$ rd.	$12\frac{1}{2}$ rd.	35. 37.5 rd.	20 rd.
36. $16\frac{2}{3}$ rd.	12 rd.	37. 8 rd.	66 ft.
38. 3.6 rd.	$2\frac{1}{2}$ rd.	39. 12.875 rd.	6.4 rd.

40. How many rods of fence would be required to inclose each lot?

41. How many acres in a lot 20 rods square?

42. What part of an acre is a lot containing 20 square rods?

43. The perimeter of a square lot is 100 rods. How many acres in the lot?

44. A square lot has an area of 25 square rods. Find the distance around it.

45. A field 80 rods by 45 rods was divided into 5 equal fields. How many acres in each lot?

46. How many acres in a lot one quarter of a mile long and one eighth of a mile wide? How many rods around the lot?

47. A park reservation 68 rods by 40 rods has 26 trees to the acre. How many trees in the reservation?

ANGLES

The difference in direction between two straight lines that meet is an *angle*.

The meeting point of the two straight lines is the *vertex* of the angle.

The lines are the sides of the angle.

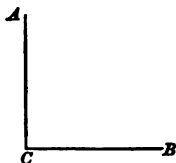


FIGURE 1

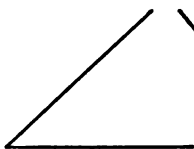


FIGURE 2

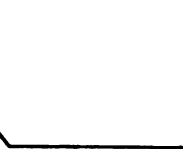


FIGURE 3

When the sides form a square corner, the angle is a *right angle*. (Fig. 1.)

When the sides form a right angle, they are *perpendicular* to each other. Thus in figure 1 the vertical line *AC* and the horizontal line *BC* are perpendicular to each other.

An angle less than a right angle is an *acute angle*. (Fig. 2.)

An angle greater than a right angle is an *obtuse angle*. (Fig. 3.)

QUADRILATERALS

A figure bounded by straight lines is a *polygon*.

A polygon of four sides is a *quadrilateral*.

Lines which have the same direction are *parallel lines*.

Quadrilaterals are classified according to their parallel sides:

(1) A quadrilateral whose opposite sides are parallel is a *parallelogram*.

(a) A parallelogram whose angles are right angles is a *rectangle*. (Fig. 1.)

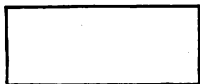


FIGURE 1



FIGURE 2



FIGURE 3



FIGURE 4

(b) A parallelogram whose sides are equal and whose angles are right angles is a *square*. (Fig. 2.)

(c) A parallelogram whose angles are oblique, *i.e.* not right angles, is an *oblique-angled parallelogram*, or a *rhomboid*. (Fig. 3.)

(d) An oblique-angled parallelogram whose sides are equal is a *rhombus*. (Fig. 4.)



FIGURE 5

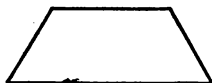


FIGURE 6

(2) A quadrilateral having two sides parallel is a *trapezoid*. (Figs. 5 and 6.)

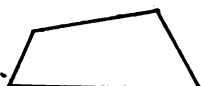


FIGURE 7

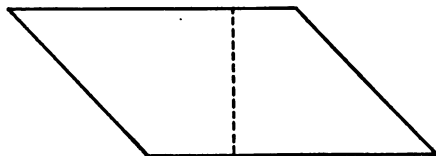


FIGURE 8

(3) A quadrilateral having no two sides parallel is a *trapezium*. (Figs. 7 and 8.)

FINDING AREAS OF PARALLELOGRAMS

1. Cut from paper a parallelogram like this — making base 4 inches and altitude 2 inches.



The altitude of a parallelogram is its height from its base.

2. Cut into two pieces and arrange the pieces to form a rectangle.

3. Compare the bases of the parallelogram and the rectangle.

4. Compare their altitudes.

5. What is the area of the rectangle? Of the parallelogram?

6. What must be known to find the area of a parallelogram?

The area of a parallelogram is equal to the product of its base and its altitude.

Find the areas of parallelograms of these dimensions :

LENGTH	WIDTH	LENGTH	WIDTH
7. 18 ft.	12½ ft.	8. 15 in.	4½ in.
9. 7½ ft.	5½ ft.	10. 18 ft. 6 in.	12 ft.
11. 1' 6"	1' 6"	12. 3' 3"	2' 6"
13. 5 yd.	8½ ft.	14. 6 yd.	4 yd. 6 in.
15. 5½ ft.	1½ ft.	16. .75 yd.	.5 yd.
17. 4.5 rd.	2.2 rd.	18. 48 ft.	15 yd.

19. Make up problems in finding areas of parallelograms.

FINDING AREAS OF TRAPEZOIDS

The altitude of a trapezoid is the perpendicular distance between its parallel sides.

1. What is the altitude of figure 1? Of figure 2?

2. Cut from paper a trapezoid like figure 1.

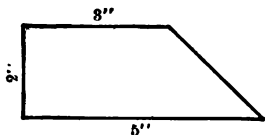


FIGURE 1

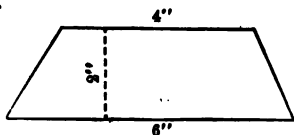


FIGURE 2

3. Fold so that the upper edge is on a line with the lower edge. Crease. Cut on the line of the crease. Arrange the two pieces to form a rectangle.

4. What two sides of the trapezoid form the base of the rectangle? What is the length of the base?

5. What is the altitude of the trapezoid? The altitude of the trapezoid is what part of the altitude of the rectangle?

6. What is the area of the rectangle? Of the trapezoid?

7. Cut from paper a trapezoid like figure 2. Fold, cut, and arrange the pieces to form a parallelogram.

8. What is the base of the parallelogram? Its altitude? Its area? What is the area of the trapezoid?

A trapezoid is equal to a parallelogram whose base is the sum of the parallel sides of the trapezoid, and whose altitude is one half the altitude of the trapezoid.

The area of a trapezoid is equal to one half the product of its altitude and the sum of its parallel sides.

9. What is the area of a trapezoid whose parallel sides are 24 feet and 16 feet, and whose altitude is 9 feet?

$$24 + 16 = 40, \text{ sum of parallel sides.}$$

$$20$$

$$\frac{40 \times 9}{2} = 180, \text{ area in square feet.}$$

Find the areas of trapezoids of these dimensions:

- | | PARALLEL SIDES | ALTITUDE |
|-----|---|----------|
| 10. | 10 ft. and 6 ft. | 5 ft. |
| 11. | 18 in. and 12 in. | 5 in. |
| 12. | 25 ft. and 15 ft. | 10 ft. |
| 13. | $2\frac{1}{2}$ ft. and $1\frac{1}{2}$ ft. | 20 in. |
| 14. | 24 rd. and 16 rd. | 14 rd. |
| 15. | 4 yd. and 3 yd. | 2 yd. |
| 16. | 7.5 ft. and 4.5 ft. | 5 ft. |
| 17. | 1.5 yd. and .8 yd. | .75 yd. |
18. What is the area of a trapezoid if the base is 20 in., the side parallel to the base 12 in., and the altitude 8 in.?
19. The two parallel sides of a trapezoid are 16 ft. and 22 ft., and the altitude is 8 ft. Find the area.
20. How many square rods in a four-sided field whose two parallel sides are, respectively, 40 rods and 30 rods, and the distance between them is 15 rods?
21. Make a problem about a trapezoid. Draw the diagram, work out the problem, and ask your teacher to give the problem to the class to solve.

TRIANGLES

A polygon of three sides is a *triangle*.

Triangles may be classified in two ways:

I. With respect to their sides.

A triangle having three equal sides is an *equilateral triangle*. (Fig. 1.)

A triangle having two equal sides is an *isosceles triangle*. (Fig. 2.)

A triangle having no two sides equal is a *scalene triangle*. (Fig. 3.)

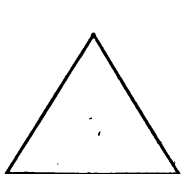


FIGURE 1

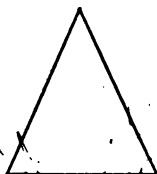


FIGURE 2

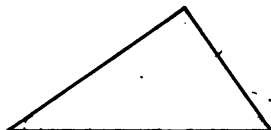


FIGURE 3

II. With respect to their angles.

A triangle having a right angle is a *right-angled triangle*. (Fig. 4.)

A triangle having three acute angles is an *acute-angled triangle*. (Fig. 5.)

A triangle having an obtuse angle is an *obtuse-angled triangle*. (Fig. 6.)

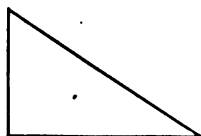


FIGURE 4

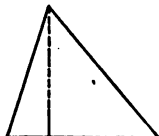


FIGURE 5



FIGURE 6

The altitude of a triangle is the perpendicular distance from the angle opposite the base to the base or to the base extended. What is the altitude of figure 4? Of figure 5? Of figure 6?

PROBLEMS

Written

1. The perimeter of an equilateral triangle is 48 inches. What is the length of one side?
2. Each of the equal sides of an isosceles triangle is 15 inches and the base is 8 inches. What is the perimeter?

3. The perimeter of a right-angled triangle is 6 inches. The base is $1\frac{1}{2}$ inches and the altitude 2 inches. What is the length of the third side?
4. The perimeter of an isosceles triangle is 15 inches. The base is 3 inches. How long is each of the other sides?
5. The sides of a scalene triangle are $1\frac{1}{2}$ inches, $2\frac{1}{4}$ inches, and 3 inches. What is its perimeter?
6. A watch charm in the shape of an equilateral triangle requires a gold band $2\frac{1}{4}$ inches long to inclose it. What is the length of one side of the charm?
7. How many feet of fencing will enclose an equilateral triangular flower bed, one of whose sides is 4.5 feet?

FINDING AREAS OF TRIANGLES

A straight line connecting the opposite corners of a quadrilateral is a diagonal. The line AB is a diagonal of figure 1.

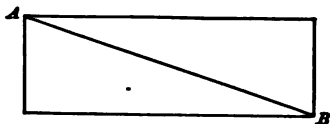


FIGURE 1

1. Cut from paper a rectangle whose base is 3 inches and whose altitude is 2 inches.
2. What is the area of this rectangle?
3. Cut along the diagonal. Compare the areas of the two triangles by placing one over the other.
4. The area of each triangle is what part of the area of the rectangle? What is the area of each triangle?

5. Cut from paper triangles like figure 2 and figure 3. Cut on dotted lines; arrange parts to form rectangles. Show that each triangle is equal to a rectangle whose base is equal to the base of the triangle and whose altitude is one half of the altitude of the triangle.

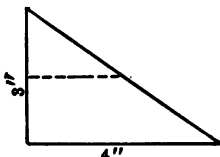


FIGURE 2

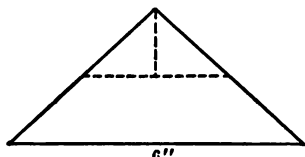


FIGURE 3

The area of a triangle is equal to one half the product of its base and its altitude.

Find areas of these triangles:

	BASE	ALTITUDE		BASE	ALTITUDE
6.	12 in.	5 in.	7.	18 in.	10 in.
8.	15 ft.	8 ft.	9.	20 ft.	15 ft.
10.	$2\frac{1}{2}$ ft.	15 in.	11.	1 ft. 8 in.	1 ft.
12.	5 yd.	3 yd.	13.	12 ft.	7.5 ft.
14.	3.5 yd.	3.5 ft.	15.	2.6 rd.	.75 rd.

16. The base of a right-angled triangle is 8 feet and the altitude is 5 feet. What is the area?

17. The base and altitude of a triangle are each 16 inches. What is the area?

18. What is the area of a triangular lot of land whose base is 20 yards and whose altitude is 25 feet?

19. How many acres in a triangular lot of land whose base and altitude are, respectively, 40 rods and 24 rods?

20. Make up problems in finding areas and perimeters of triangles.

DRAWING TO SCALE

Written

1. Make a diagram of the top surface of the teacher's desk. Scale $\frac{1}{2}" = 1'$.

2. Make a diagram of the side of the teacher's desk facing the school, on a scale of $\frac{1}{2}" = 1'$.

3. Represent on paper the area of the schoolroom floor. Scale $1" = 8'$.

Compute the number of square feet in the floor.

Compute the cost of the floor boards at 6 cents per square foot.

4. Make a diagram of a picture $24"$ by $20"$ surrounded by a $2"$ frame. Scale $\frac{1}{4}" = 2"$.

5. Make a diagram of the door leading from the schoolroom into the hall, on a scale of 1 inch = 1 foot.

6. Make a diagram of the lower sash of one of the schoolroom windows, letting 1 inch represent 6 inches. Compute the area of the lighting surface.

7. Draw a rectangle $2\frac{3}{4}$ inches by $1\frac{1}{2}$ inches. This figure represents the ground plan of a house drawn on a scale of $\frac{1}{4}$ inch to 4 feet. Find the dimensions of the house and the area covered by the house.

8. Four adjoining house lots are, respectively, 45 ft., 60 ft., 90 ft., and 75 ft. on the street side. Each lot is 120 ft. deep.

(a) Draw a diagram of the lots on a scale of 1 inch to 60 feet.

(b) Compute the values of the lots at $18\frac{3}{4}$ cents per square foot.

- (c) What is the area of all the lots?
 (d) What is the perimeter of each lot?

9. In many places building lots are sold by the street frontage. At \$22.75 per front foot, what is the value of each lot in problem 8?

10. The diagram of a park covers a space $3\frac{1}{2}''$ by $5''$. $1''$ represents 24 rods. What are the dimensions of the park? Its area in acres?

11. On a scale of $\frac{1}{2}''$ to $1'$ make a diagram of a floor $16'$ by $12'$, and on it a rug 3 yd. by 2 yd. Compute the areas of the floor and of the rug in square feet.

12. Make a diagram of a mirror whose outside dimensions are 32 inches by 20 inches. Scale $\frac{1}{4}''=1$ foot.

13. Make a drawing of a 2-inch picture frame whose outside dimensions are 32 inches by 24 inches. Scale 1 inch to 8 inches.

14. Find from a geography map the distance from New York to Chicago. From Chicago to St. Louis. From St. Louis to Denver. From Denver to San Francisco.

15. Using some map in your geography, find the dimensions of the state of Colorado. Compute its area in square miles.

16. Find the dimensions and area of Wyoming. Of Kansas. Of Utah. Of Nevada. Of other states.

SCALES AND GRAPHS *Oral and Written*

Scales are indicated in various ways, as, for instance:

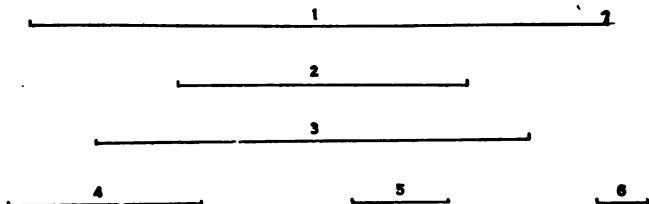
(1) $1''=3'$. This means that a line 1 in. long is used to represent a length of 3 ft.

(2) $\frac{1}{4}$. This means that one unit of real length is used to represent four units of real length.

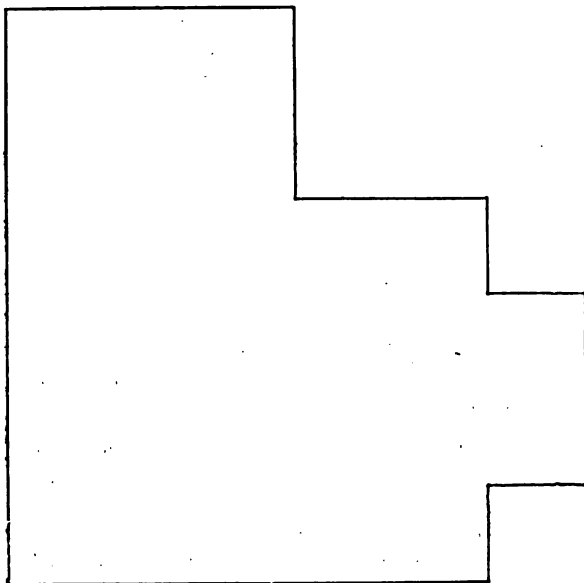
(3) $\overset{0}{\text{-----}}\overset{5}{\text{-----}}$
 RODS. This means that a line of the given length is used to represent a real length of 5 rd.

1. Read these scales, and tell what each means: $1'' = 2$ rd.; $\frac{1}{6}$; $\overset{0}{\text{---}} \overset{3}{\text{---}}$
YARDS

2. Using the scale $\overset{0}{\text{---}} \overset{2}{\text{---}}$ MILES, find the lengths represented by the following lines:



This diagram shows the ground plan of a house drawn to the scale $1'' = 10'$.



3. Find the real length represented by each line of the diagram.

4. Tell how to find the perimeter of the house.

5. Tell how to find the area covered by the house.

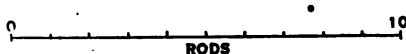
Reading real lengths from plotted lengths is *reducing plotted lengths to real lengths*.

6. On the scale $1'' = 8'$, what length of line will represent 16 ft.? 24 ft.? 4 ft.? 2 ft.? 1 ft.? 5 ft.?

7. On the scale $1'' = 4$ yd., draw a line representing a distance of 8 yd. 12 yd. 6 yd. 10 yd. 2 yd. 3 yd.

Representing real lengths on a scale is *reducing real lengths to plotted lengths*.

8. On the scale plot the diagram of



a lot 30 rd. by 25 rd. Of one 24 rd. by 18 rd.

9. On the scale $\frac{1}{4}$, draw a line showing a real length of 4". 8". 6". 12". 2". 10".

10. On the scale draw a line represent-



ing 20 ft. 5 ft. 25 ft. 30 ft. 15 ft.



11. On the scale draw a line representing the distance John rides his bicycle in one week—45 miles.

12. On a map appears this legend, "Scale, $1\frac{1}{4}$." What does it mean? If all the dimensions are given in feet, what length of line will represent 100 ft.? 50 ft.? 175 ft.? $12\frac{1}{2}$ ft.? $62\frac{1}{2}$ ft.?

13. Using the scale $1'' = 6$ yr., draw lines showing the ages of two children who are 9 yr. and 12 yr., respectively.

Frequently facts may be shown so clearly by diagrams or graphs that the picture method is often used to convey certain kinds of information where comparison is desired.

The following diagram is a picture or graphic representation of the number of pupils in certain schools of a city.

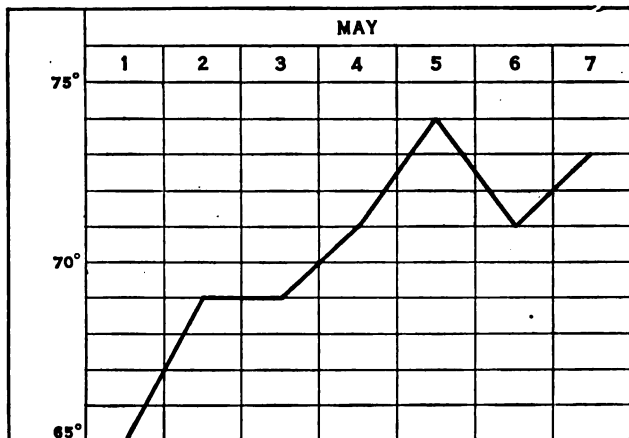


Each of the vertical spaces represents 100 pupils. Therefore at a glance we can see the number of pupils in each school, and note the comparative size of the schools. Since the line representing the Adams school fills six spaces, we know that there are 600 pupils in that school. In like manner, we read that there are 350 pupils in the Green school.

14. Tell how many pupils in each of the other schools.

15. Letting one division of space represent 1000 sq. mi., draw a diagram showing the comparative areas of the following states whose approximate area is given in square miles: Vermont, 9500; Massachusetts, 8000; New Jersey, 7750; Connecticut, 5000; Delaware, 2000; Rhode Island, 1250.

Another form of diagram is also frequently used to express two series of facts at the same time, as, for instance, the following graph showing the temperature at noon on each day of the first seven days in May.



From the graph we readily see that on May 1 the thermometer registered 65°; on May 2, 69°; on May 3, 69°; on May 4, 71°; on May 5, 74°; on May 6, 71°; and on May 7, 73°.

16. Keep a record of the thermometer readings for a week, and then plot the record.

17. Make a graph showing your record in arithmetic for one week.

CUBIC OR VOLUME MEASURE

Oral

A volume or solid has three dimensions—length, width, and thickness.

A solid bounded by six rectangles is a rectangular prism. (Fig. 1.)

If the six rectangles are squares, the solid is a cube (Fig. 2.)

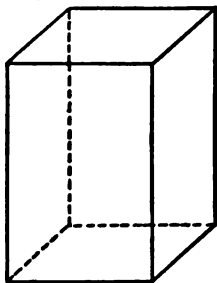


FIGURE 1

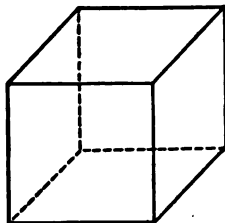


FIGURE 2

1. A 1-foot cube is a cube — inches long, — inches wide, and — inches thick. It contains — cubic inches.

2. A 1-yard cube is a cube — feet long, — feet wide, and — feet thick. It contains — cubic feet.

Cubic measure is used in measuring volumes.

3. Learn:

TABLE OF CUBIC MEASURE

1728 cubic inches (cu. in.)	= 1 cubic foot (cu. ft.)
27 cubic feet	= 1 cubic yard (cu. yd.)

A load of earth, sand, etc., is a cubic yard.

4. How many inch cubes can be cut from a cubic foot of wood?

5. What is the volume of a 2-inch cube?

6. A 2-inch cube is how many times as large as 2 cubic inches?

7. How many 1-inch cubes are required to build a 4-inch cube?

8. How many 2-inch cubes are equal in volume to a 4-inch cube?

9. How many blocks 1 inch \times 1 inch \times 1 inch can be packed in a box 4 inches \times 2 inches \times 3 inches?

10. A cubic foot is equal to how many 6-inch cubes?

11. A block of wood 8 inches long, 4 inches wide, and 2 inches thick will make how many 1-inch cubes?

12. A cake of ice 1 yard long, 1 yard wide, and 1 yard thick is cut into cakes 1 foot long, 1 foot wide, and 1 foot thick. How many?

13. A cubic foot is what part of a cubic yard?

14. Nine cubic feet are what part of a load of sand?

15. Thirty-six cubic yards are how many cubic feet?

16. Twenty-seven hundred cubic feet of earth are carted for filling. How many loads?

FINDING VOLUMES *Oral and Written*

The volume of a solid is the number of cubic units it contains.

1. What is the volume of a rectangular prism 4 inches long, 2 inches wide, and 6 inches high?

Figure 3 represents the prism. Figure 4 represents 1 cubic inch. The problem is to find how many cubic units like figure 4 there are in figure 3.

The unit of measurement is 1 cubic inch.

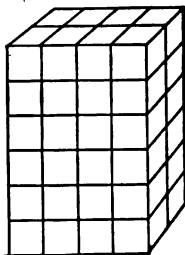


FIGURE 3



FIGURE 4

In the front row of the lowest layer there are 4 cubic inches.

In both rows of the layer there are 2 times 4 cubic inches, or 8 cubic inches.

In the six layers there are 6 times 8 cubic inches, or 48 cubic inches.

The steps taken are:

First. Determine the unit of measurement.

Second. Find the number of cubic units in 1 row.

Third. Multiply the number of cubic units in 1 row by the number of rows.

Fourth. Multiply the number of cubic units in 1 layer by the number of layers.

Think first of the unit of measurement.

The volume of a solid can always be found by multiplying together its length, its width, and its height, when all are expressed in the same unit of measurement (inches, feet, yards, etc.).

Find the volumes of these prisms:

	LENGTH	BREADTH	HEIGHT		LENGTH	BREADTH	HEIGHT
2.	10 ft.	3 ft.	6 ft.	3.	12 in.	6 in.	5 in.
4.	9 yd.	4 yd.	5 yd.	5.	4 ft.	$2\frac{1}{2}$ ft.	1 ft.
6.	3.5 ft.	2 ft.	1.5 ft.	7.	3 ft.	2.5 ft.	.5 ft.
8.	3 ft.	9 in.	6 in.	9.	4 yd.	9 ft.	2 ft.
10.	8 ft.	6 ft.	2 yd.	11.	9 ft.	2 yd.	5 ft.
12.	1 yd.	1 ft.	2 ft.	13.	27 in.	2 ft.	9 in.

14. Mr. Hubbard has in his barn an oat bin $6\frac{1}{2}$ feet long, 3 feet wide, and 4 feet deep. What is its capacity in cubic feet?

- X 15. A wood box covers on the floor a space 2 ft. \times $1\frac{1}{2}$ ft. It stands 2 ft. 4 in. high. How many cubic feet does the box occupy?
- / 16. At 62.5 pounds to a cubic foot, what is the weight of the water contained in a tank 4 feet by 8 feet by 2 feet?
- / 17. A cubic foot of ice weighs 57.5 pounds. What is the weight of a cake 2 feet long, 2 feet wide, and $1\frac{1}{2}$ feet thick?
- X 18. How many loads of earth were removed in digging a cellar 24 feet long, 18 feet wide, and 6 feet deep?

Study these solutions:

$$(1) 24 \times 18 \times 6 = 2592$$

The product of the dimensions expressed in feet represents the contents in cubic feet.

$$2592 \div 27 = 96$$

The number of cubic feet of earth removed divided by the number of cubic feet in one load gives the number of loads.

$$(2) \begin{array}{r} 2 \quad 2 \\ 24 \times 18 \times 6 \\ \hline 27 \end{array} = 96$$

$24 \times 18 \times 6$ represents what?
 $\frac{24 \times 18 \times 6}{27}$ represents what?

In problem work always select the shortest method.

Find the number of loads of earth removed in digging a cellar:

- X 19. 18 feet by 21 feet by 6 feet.
- X 20. 24 feet by 30 feet by 6 feet.
- + 21. 36 feet by 30 feet by 7 feet.
- / 22. 28 feet by 36 feet by 9 feet.

23. Baseballs are put up in pasteboard cases 3 inches long, 3 inches wide, and 3 inches high. How many can be packed in a box 18 inches long, 15 inches wide, and 12 inches deep?

24. A pile of wood 8 feet long, 4 feet wide, and 4 feet high is 1 cord. How many cubic feet in a cord?

25. One eighth of a cord is a cord foot. How many cubic feet in a cord foot?

26. Learn:

TABLE OF WOOD MEASURE

16 cubic feet = 1 cord foot (cd. ft.)
 8 cord feet (128 cubic feet) = 1 cord (cd.)

27. How many cords in a pile of wood 16 feet by 4 feet by 4 feet?

28. How many cord feet in a pile of wood 4 feet by 4 feet by 4 feet?

29. At \$1.25 per cord foot, what is a cord of maple wood worth?

30. Mr. Baldwin bought 8 cord feet of pine wood for \$1.50. What was the rate per cord?

31. How many cords of spruce in a pile containing 704 cubic feet?

32. How many cords of hard wood in a pile containing 704 cord feet?

Find the number of cords of wood in piles of these dimensions:

	LENGTH	WIDTH	HEIGHT		LENGTH	WIDTH	HEIGHT
33.	8 ft.	4 ft.	8 ft.	34.	15 ft.	4 ft.	6 ft.
35.	20 ft.	4 ft.	12 ft.	36.	12 ft.	4 ft.	10 ft.
37.	25 ft.	4 ft.	8 ft.	38.	18 ft.	4 ft.	6 ft.

39. At \$8 a cord, what is the value of a pile of wood 12 feet long, 4 feet wide, and 9 feet high?

40. How many cords of bark in a pile 16 feet long, 8 feet wide, and 10 feet high?

41. A freight car 30 feet long has on it a pile of pine wood 8 feet wide and 8 feet high. How many cords?

SURFACES OF RECTANGULAR PRISMS

1. Draw on cardboard or stiff paper a diagram like figure 2. Cut it out. Crease on dotted lines and fold to make a rectangular prism like figure 1. Sew, pin, or paste the edges together.

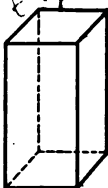


FIGURE 1

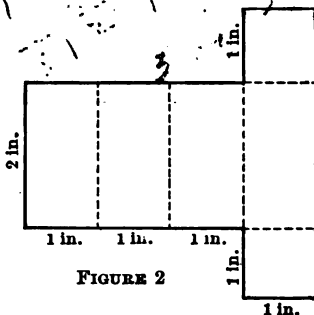


FIGURE 2

How many sides or faces has this prism? What is the area of the top and bottom faces? Of the front and back faces? Of the two side faces? Of the six faces?

2. Draw a diagram showing the faces of a 2-inch cube.

3. What is the surface area of a 5-inch cube? Of a 6-inch cube?

4. Represent by diagram the surface of a block of wood 2 inches by 2 inches by 3 inches. What is the surface area?

5. Make a diagram showing the surface of a brick 8 inches long, 4 inches wide, and 2 inches thick. Scale $1'' = 2''$. What is the surface area?

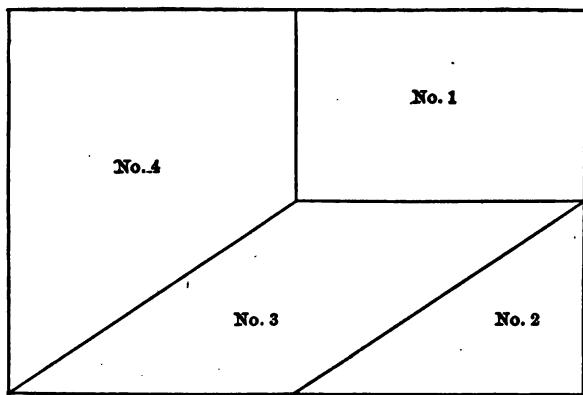
6. What is the surface area of a box 12 inches by 9 inches by 3 inches? Scale $1'' = 3''$.

7. Find the surface areas of the prisms in examples 2 to 13 on page 104.

8. Make a diagram of the outside surface of a rectangular collar box without cover. Of an envelope box.

REVIEW EXERCISE*Written*

1. This diagram represents a field divided into four lots. Copy it, and answer these questions about it



Scale $\frac{1}{2}'' = 20$ rods

(1) What kind of figure is lot No. 1? What are its dimensions? What is its area in acres?

(2) What kind of figure is lot No. 2? What are its dimensions? Its area in acres?

(3) What name is given to a figure like lot No. 3? What is the length of its base? Its altitude? How many acres in the lot?

(4) What kind of figure is lot No. 4? What dimensions must be known to find its area? Find its area in acres.

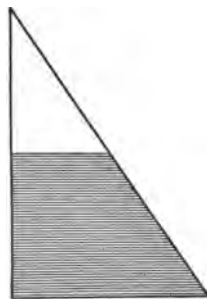
(5) Find the sum of the areas of the lots. Find a way of testing your answer.

(6) What is the perimeter of the field in rods? In feet? In miles?

2. Draw a right-angled triangle, an acute-angled triangle, and an obtuse-angled triangle whose bases are 4 inches and whose altitudes are 3 inches. Compare their areas.

3. What is the area of the shaded part of this figure? The unshaded part? What is the sum of the two parts? Test the last answer by finding the area of the figure in another way.

4. Draw a diagram showing the surface area of a block of wood 2 inches square and 3 inches high. Compute the area.



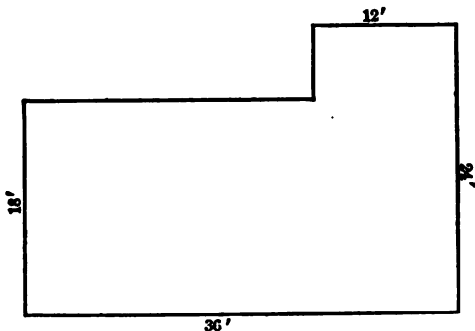
Scale $\frac{1}{2}$ " = 6'

5. The following diagram represents a cellar floor.

(1) Draw a plan of it, letting $\frac{1}{2}$ inch represent 3 feet.

(2) What is the perimeter of the plan? How many feet does it represent? How many yards?

(3) What is the area in square feet of the cellar floor?
In square yards?



(4) The cellar was excavated to a depth of 6 feet. How many cubic feet of earth were removed? How much did the labor cost at \$1 a load?

(5) A cement floor 3 inches thick was laid in the cellar. How many cubic feet of material were used? How many cubic yards?

LIQUID MEASURE *Oral and Written*

4 gills (gi.)	= 1 pint (pt.)
2 pints	= 1 quart (qt.)
4 quarts	= 1 gallon (gal.)

1. A pint is what part of a quart? Of a gallon?
2. A quart is what part of a gallon?
3. What part of a gallon is 2 quarts? 3 quarts?
4. At 4 cents a pint a quart of milk will cost — cents, and a gallon will cost — cents.
5. At 90 cents a quart, what will a gallon of olive oil cost? A pint?

6. Express 15 quarts as gallons; as pints.
7. Express 17 pints as quarts; as gallons.
8. How many pints in 2 gal. 3 qt.? In $5\frac{3}{4}$ gal.?
9. How many pints in 2 gal. 1 qt.? In 1 gal. 1 qt. 1 pt.?

10. How many pints of cream in a gallon-jar $\frac{3}{4}$ full? At $3\frac{1}{2}$ cents a quart, what is received for a can of milk containing 2 gallons 1 quart?

11. How many quart jars can be filled from a kettle containing $2\frac{3}{4}$ gallons of preserves?

12. How many gallons of sirup in a dozen bottles each holding $\frac{1}{3}$ of a quart?

13. A barrel of vinegar ($31\frac{1}{2}$ gallons) is to be put up in half-gallon bottles. How many bottles will be required?

14. A 5-gallon carboy of spring water costs 25 cents. What is the rate per quart?

15. At 64 cents a gallon, what is the cost of $1\frac{1}{2}$ pints of machine oil?

16. At 5 cents a quart, how much must be paid for 1 gallon 2 quarts of vinegar?

17. How many gallons in 2 dozen bottles, each holding 1 quart 1 pint?

18. How many half-pint bottles can be filled from a jug containing 2 gallons 2 quarts 2 pints?

19. Mr. Chapin uses a gallon of gasoline in driving his automobile 18 miles. How far can he go if he has 4 gallons 3 quarts of gasoline?

20. At 15 cents a gallon, how much does it cost Mr Chapin to run his automobile 1 mile?

32
64
96

DRY MEASURE

Oral and Written

2 pints (pt.)	= 1 quart (qt.)
8 quarts	= 1 peck (pk.)
4 pecks	= 1 bushel (bu.)

- Express as bushels: 20 pecks; 2 bu. 4 qt.; 1 bu. 7 qt.; 72 qt.
- Express as pecks: $\frac{4}{5}$ bu.; 1 bu. 3 pk.; 15 qt.; 4 bu.
- Express as quarts: $1\frac{3}{4}$ pecks; 2 bu. 3 pk.; $2\frac{3}{4}$ pk.; $\frac{1}{2}$ bu.
- At 2 cents a quart a peck of corn will cost — cents, and a bushel will cost — cents.
- A quart is what part of a peck? Of a bushel?
- What part of a peck is 1 quart? 3 quarts? 5 quarts? 7 quarts? 2 quarts? 4 quarts? 6 quarts?
- What part of a bushel is 1 peck? 3 pecks? 2 pecks?
- A bushel of oats weighs 32 pounds. What is the weight of a peck? A quart? $1\frac{3}{4}$ bushels? $2\frac{1}{2}$ pecks?
- A bushel of corn weighs 56 pounds. What is the weight of a peck? A quart? $1\frac{1}{2}$ bushels?
- A bushel of wheat weighs 60 pounds. What is the weight of a peck? A quart? $\frac{3}{4}$ of a bushel? $2\frac{1}{2}$ bushels?
- At 12 cents a quart, what will $2\frac{1}{2}$ pecks of cranberries cost?
- If a berry basket holds $\frac{3}{8}$ of a quart, how many baskets can be filled from a bushel of blueberries?
- How many boxes, each containing $2\frac{1}{2}$ pecks, can be filled from a bin holding 25 bushels of apples?

AVOIRDUPOIS WEIGHT

Oral

1. Learn:

TABLE OF AVOIRDUPOIS WEIGHT

16 ounces (oz.)	= 1 pound (lb.)
100 pounds	= 1 hundredweight (cwt.)
2000 pounds	= 1 ton (T.)
2240 pounds	= 1 long ton

The long ton is used in measuring coal and ore at the mines, etc.

2. How many pounds in 25 ounces? In 60 ounces?

3. How many ounces in $\frac{1}{2}$ of a pound? $\frac{1}{4}$? $\frac{3}{4}$? $\frac{1}{8}$? $\frac{3}{8}$?
 $\frac{5}{8}$? $\frac{7}{8}$? $\frac{1}{16}$? $\frac{5}{16}$? $\frac{7}{16}$?

4. How many 100-pound bags of coal in 1 ton?

5. How many tons in 2500 pounds? 3000 pounds?
 5000 pounds? 7500 pounds?

Express as fractions of a ton:

6. 1000 pounds 500 pounds 1500 pounds 400 pounds

7. 800 pounds 1200 pounds 1600 pounds 200 pounds

PROBLEMS

Written

X 1. A piece of butter weighs 8 pounds 10 ounces.
 How much is it worth at 36 cents a pound?

X 2. At 20 cents a pound, what is the cost of a piece of
 cheese weighing 20 ounces?

X 3. What is the rate per ton when a 100-pound bag of
 fertilizer costs \$1.75?

X₄. Make out Mr. Alfred S. Hosmer's bill for .75 of a ton of fertilizer at \$36 a ton.

X₅. At the rate of \$18 a ton, how much will 2 tons 12 hundred pounds of hay cost?

6. How many ordinary tons in a shipment of 30,000 pounds of coal? How many long tons?

7. A farmer received \$40 for $1\frac{1}{2}$ tons of potatoes, selling them by the bushel of 60 pounds. How much did he receive per bushel?

8. A cubic foot of water weighs 1000 ounces. How many pounds?

9. How many cubic feet of water weigh 1 ton?

4200 10. These numbers represent the weight in
3750 pounds of twelve loads of coal delivered at a
4750 schoolhouse.

4840 (1) What was the weight of each load in tons?

4290 (2) What was the total weight in pounds?

4370 In tons?

4760 (3) Find the cost at \$5.84 a ton.

5860 (4) How many long tons in all the loads?

5480 11. Mr. Bartlett bought a ton of fertilizer
4530 for \$37.50, and retailed it by the hundred-
4920 weight at the rate of $2\frac{1}{2}$ cents a pound. What
4250 was his profit?

EXERCISES

1. Change 51 qt. to gal.

SOLUTION—4 qt. = 1 gal. $51 \text{ qt.} \div 4 = 12\frac{3}{4} \text{ gal.}$

Changing from a lower to a higher denomination is *reduction ascending*.

2. Change 3 mi. 84 rd. to rd.

SOLUTION—1 mi. = 320 rd. 3 mi. = 3×320 rd. = 960 rd. 960 rd. + 84 rd. = 1044 rd.

Changing from a higher to a lower denomination is *reduction descending*.

3. Express 7 pk. 6 qt. as pk.

SOLUTION—Since 8 qt. = 1 pk., 6 qt. = $\frac{3}{4}$ pk. = $\frac{3}{4}$ pk. 7 pk. 6 qt. = $7\frac{3}{4}$ pk.

4. Express 5 gal. 3 qt. as gal. and decimal of a gal.

SOLUTION—Since 4 qt. = 1 gal., 3 qt. = $\frac{3}{4}$ gal. $\frac{3}{4}$ = .75. $\frac{3}{4}$ gal. = .75 gal. 5 gal. 3 qt. = 5.75 gal.

5. Change $\frac{1}{4}$ mi. to rd.

SOLUTION—1 mi. = 320 rd. $\frac{1}{4}$ of 320 rd. = 140 rd.

6. Change .625 A. to sq. rd.

SOLUTION—1 A. = 160 sq. rd. .625 of 160 sq. rd. = 100 sq. rd.

7. Add 8 ft. 7 in., 5 ft. 4 in., and 6 ft. 10 in.

SOLUTION—

FT.	IN.	
8	7	10 in. + 4 in. + 7 in. = 21 in. = 1 ft. 9 in. Write 9 in
5	4	the in. column, and add 1 to the numbers in the ft.
6	10	column.
20	9	

8. Subtract 3 yd. 2 ft. from 9 yd. 1 ft.

SOLUTION—

YD.	FT.	
9	1	Since we cannot take 2 ft. from 1 ft., we change 1
3	2	of the 9 yd. to ft. and add to 1 ft. 1 ft. + 3 ft. = 4 ft.
5	2	4 ft. - 2 ft. = 2 ft. 8 yd. - 3 yd. = 5 yd.

9. Multiply 4 hr. 18 min. by 5.

SOLUTION—

HR.	MIN.	
4	18	Five times 18 min. = 90 min. = 1 hr. 30 min. Write
	5	30 in the min. column and add 1 hr. to 5 times 4 hr.,
21	30	making 21 hr.

10. Divide 26 bu. 1 pk. by 3.

SOLUTION—

BU.	PK.	
3)26	1	26 bu. \div 3 = 8 bu., with 2 bu. remaining. 2 bu. =
8	3	8 pk. 1 pk. + 8 pk. = 9 pk. 9 pk. \div 3 = 3 pk.

- ✕ 11. Change 150 oz. to lb.
- ✕ 12. Change 5 pk. 5 qt. to qt.
- ✕ 13. Multiply 3 mi. 287 rd. by 8.
- ✕ 14. From 17 A. 75 sq. rd. take 5 A. 139 sq. rd.
- ✕ 15. Find the sum of 16 sq. yd. 5 sq. ft., 7 sq. yd. 7 sq. ft., 12 sq. yd. 3 sq. ft., and 6 sq. yd. 4 sq. ft.
- ✕ 16. Divide 18 cu. yd. 8 cu. ft. by 4.
- ✕ 17. Five tubs of butter weighed 32 lb. 4 oz., 28 lb. 11 oz., 37 lb. 15 oz., 35 lb. 9 oz., 29 lb. 5 oz., respectively. Find the total weight. The average weight.
- ✕ 18. Express 285 min. as hr. and decimal of an hr.
- ✕ 19. An express train makes a run in 4 hr. 36 min., and a freight train makes the same run in 10 hr. 50 min. How much longer time does the latter take?
- ✕ 20. A rectangular field is 40 rd. 12 ft. long and 28 rd. 8 ft. wide. Find its perimeter in rd. and ft. In ft.
- ✕ 21. Mr. Lewis has a field containing 4 A. 112 sq. rd. Express the area (1) as A. and fraction of an A., (2) as A. and decimal of an A., and (3) as sq. rd.
- ✕ 22. The distance around a square park is 1 mi. 128 rd. What is the length of one side?
- ✕ 23. On a freight car are 6 iron columns, each weighing 1 T. 1475 lb. What is the total weight of the columns?

PERCENTAGE

Oral

1. How many cents in a dollar?
2. How many hundredths of a dollar is 1 cent? 10 cents? 25 cents? 50 cents? 62 cents? 87 cents? 100 cents?

62
320

3. Into how many hundredths can a mile be separated? An acre of land? A bushel of grain? A barrel of flour? Any thing?

When we think of a thing as divided into 100 equal parts, we speak of $\frac{1}{100}$, or .01, of it as 1 *per cent* of it; .05 of it as 5 per cent of it; .50 of it as 50 per cent of it. and so on.

The expression *per cent* is an abbreviation of the Latin phrase *per centum*, meaning *by the hundred*.

Reckoning by the hundred is such an easy way of computation that it is largely used in business.

The sign % means the same as the words per cent. Thus, 25 per cent and 25 % mean the same thing.

There is no principle in percentage not already used in integers and fractions. In percentage we are simply thinking of things as made up of 100 equal parts, or 100 hundredths.

4. What per cent of a century is $\frac{1}{100}$ of it? $\frac{2}{100}$ of it? $\frac{97}{100}$ of it?

5. What per cent of a mile is .01 of it? .17 of it? .56 of it?

6. What per cent of any thing is $\frac{18}{100}$ of it? .25 of it? $\frac{100}{100}$ of it?

7. What per cent of 1 yard is 1 yard? What per cent of a yard is $\frac{1}{2}$ of a yard? $\frac{1}{4}$ of a yard? $\frac{3}{4}$ of a yard?

8. What per cent of 1 is 1? What per cent of 1 is 2? What per cent of 1 is 4?

9. What per cent of a thing is the whole of it? $\frac{1}{2}$ of it? $\frac{1}{4}$ of it? $\frac{1}{8}$ of it? $\frac{1}{10}$ of it?

10. What per cent of 1 is $\frac{1}{2}$? What per cent of 1 is $\frac{1}{4}$? $\frac{3}{4}$?

11. Grace spelled 90 per cent of the words in the spelling lesson. What per cent of the words did she misspell?

12. The grocer sold a barrel of flour at a loss of 10 per cent. What per cent of the cost did he receive?

13. Foxes killed 25 per cent of Mr. Marston's chickens. What per cent was left?

14. If he had 60 at first, how many were killed? How many were left?

15. Express these per cents decimally :

1 % 7 % 9 % 21 % 37 % 63 % 71 % 93 %

16. Express these decimals with the sign % :

.01 .03 .11 .17 .41 .67 .83 .97

FRACTIONS AS EQUIVALENT PER CENTS

1. How many hundredths of a dollar is the whole of it? What per cent of it?

2. $\frac{1}{2}$ of a dollar is how many hundredths of it? What per cent of it?

Express as hundredths and as per cents :

Thus, $\frac{1}{2} = \frac{50}{100} = .50 = 50\%$; $\frac{1}{3} = \frac{33\frac{1}{3}}{100} = .33\frac{1}{3} = 33\frac{1}{3}\%$

3. $\frac{1}{4}$

4. $\frac{3}{4}$

5. $\frac{1}{4}$

6. $\frac{1}{5}$

7. $\frac{2}{5}$

8. $\frac{3}{5}$

9. $\frac{4}{5}$

10. $\frac{5}{6}$

11. $\frac{1}{10}$

12. $\frac{3}{10}$

13. $\frac{7}{10}$

14. $\frac{9}{10}$

15. $\frac{10}{10}$

16. $\frac{1}{20}$

17. $\frac{3}{20}$

18. $\frac{7}{20}$

19. $\frac{11}{20}$

20. $\frac{20}{20}$

21. $\frac{1}{25}$

22. $\frac{6}{25}$

23. $\frac{16}{25}$

24. $\frac{21}{25}$

25. $\frac{25}{25}$

26. $\frac{3}{50}$

27. $\frac{40}{50}$

28. $\frac{1}{3}$	29. $\frac{2}{3}$	30. $\frac{3}{8}$	31. $\frac{1}{8}$	32. $\frac{5}{8}$
33. $\frac{6}{8}$	34. $\frac{1}{8}$	35. $\frac{3}{8}$	36. $\frac{5}{8}$	37. $\frac{7}{8}$
38. $\frac{8}{8}$	39. $\frac{1}{12}$	40. $\frac{1}{12}$	41. $\frac{1}{16}$	42. $\frac{1}{16}$

PER CENTS AS EQUIVALENT FRACTIONS

Express these per cents as common fractions in their lowest terms; thus, $50\% = \frac{50}{100} = \frac{1}{2}$; $33\frac{1}{3}\% = \frac{33\frac{1}{3}}{100} = \frac{1}{3}$:

1. 50% 2. 25% 3. 75% 4. 20% 5. 40%
 6. 60% 7. 80% 8. 10% 9. 30% 10. 70%
 11. 90% 12. 5% 13. 4% 14. 2% 15. 1%
 16. $33\frac{1}{3}\%$ 17. $66\frac{2}{3}\%$ 18. $16\frac{2}{3}\%$ 19. $83\frac{1}{3}\%$ 20. $12\frac{1}{2}\%$
 21. $37\frac{1}{2}\%$ 22. $62\frac{1}{2}\%$ 23. $87\frac{1}{2}\%$ 24. $8\frac{1}{2}\%$ 25. $6\frac{1}{4}\%$

PER CENTS EXPRESSED IN DIFFERENT WAYS

Five per cent may be expressed in five different ways:

(1) 5 per cent: (2) 5%; (3) .05; (4) $\frac{5}{100}$; (5) $\frac{1}{20}$.

Write these per cents in different ways:

1. 10% 2. 20% 3. 25% 4. 30% 5. 40%
 6. 50% 7. 60% 8. 70% 9. 75% 10. 80%
 11. 90% 12. 6% 13. 8% 14. 15% 15. 32%
 16. 55% 17. 72% 18. 84% 19. 85% 20. 96%

Fill the blanks:

Oral

21. $10\% = \frac{1}{10} = \frac{2}{20} = \frac{3}{30} = \frac{4}{40} = \frac{5}{50} = \frac{6}{60} = \frac{7}{70} = \frac{8}{80}$.

22. $50\% = \frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \frac{5}{10} = \frac{6}{12}$ and so on to $\frac{50}{100}$.

23. $25\% = \frac{1}{4} = \frac{2}{8} = \frac{3}{12} = \frac{4}{16} = \frac{5}{20} = \frac{6}{24}$ and so on to $\frac{25}{100}$.

24. $20\% = \frac{1}{5} = \frac{2}{10} = \frac{3}{15} = \frac{4}{20} = \frac{5}{25}$ and so on to $\frac{20}{100}$.

25. In like manner write the fractional equivalents of other per cents.

Some per cents have such simple fractional equivalents that they should be memorized and used whenever possible in solving problems. The following table gives the more common ones.

TABLE OF EQUIVALENTS

$50\% = \frac{1}{2}$	$20\% = \frac{1}{5}$	$10\% = \frac{1}{10}$	$33\frac{1}{3}\% = \frac{1}{3}$	$12\frac{1}{2}\% = \frac{1}{8}$
$25\% = \frac{1}{4}$	$40\% = \frac{2}{5}$	$30\% = \frac{3}{10}$	$66\frac{2}{3}\% = \frac{2}{3}$	$37\frac{1}{2}\% = \frac{3}{8}$
$75\% = \frac{3}{4}$	$60\% = \frac{3}{5}$	$70\% = \frac{7}{10}$	$16\frac{2}{3}\% = \frac{1}{6}$	$62\frac{1}{2}\% = \frac{5}{8}$
	$80\% = \frac{4}{5}$	$90\% = \frac{9}{10}$	$83\frac{1}{3}\% = \frac{5}{6}$	$87\frac{1}{2}\% = \frac{7}{8}$

NOTE. Drill should be given on the above table until equivalents are mastered.

FINDING THE PERCENTAGE OF A NUMBER

Oral and Written

The per cent of a number or a quantity is the *percentage*.

Thus, 10 % of 80 is 8; 8 is the percentage. 25 % of \$20 is \$5; \$5 is the percentage.

1.	10	20	30	40	50
	120	Find 10 % of			60
	110	100	90	80	70

In the center space use 20 % ; 30 % ; 40 % ; 50 % ; 60 % ; 70 % ; 80 % ; 90 % .

2.	16	40	64	80	24
	8	Find 25 % of			48
	88	56	32	96	72

In the center space use $12\frac{1}{2}\%$; 50 % ; $37\frac{1}{2}\%$; $62\frac{1}{2}\%$; 75 % ; $87\frac{1}{2}\%$.

3.

12	30	6	48	66
72	Find 50 % of			18
60	42	24	54	36

In the center space use $16\frac{2}{3}\%$; $33\frac{1}{3}\%$; $66\frac{2}{3}\%$; $83\frac{1}{3}\%$.

4. Find :

10%	$16\frac{2}{3}\%$	20%	25%	30%	$33\frac{1}{3}\%$	40%
100%	of 60 minutes					50%
90%	$83\frac{1}{3}\%$	80%	75%	70%	$66\frac{2}{3}\%$	60%

Write in the center space \$1.20 ; 240 acres of land ; \$300 ; 420 barrels of oil ; and so on.

5. Find :

100%	10%	$12\frac{1}{2}\%$	20%	25%	30%	$37\frac{1}{2}\%$
90%	of \$0.40					40%
$87\frac{1}{2}\%$	80%	75%	70%	$62\frac{1}{2}\%$	60%	50%

Write in the center space 80 bushels ; 160 square rods ; \$200 ; 320 rods ; 360 days ; and so on.

Make up problems based on the combinations given in the five exercises above.

PROBLEMS

Oral

1. Carl has completed 60 % of his work. How much remains to be done?

2. Mary's record in a spelling test was 90 %. There were 50 words. How many did she spell correctly?

3. Charles paid 50 cents for a knife. He sold it for 20 % less than he paid. How much did he lose?

4. Edward paid 60 cents for his knife. He sold it for 25 % more than he paid. How much did he gain?

5. A baseball team's standing is given as 75 %. What does this mean? How many of the 48 games played has it won?

6. A loaf of bread costs the baker 4 cents. He sells it at a gain of 25 %. How much does he receive for it?

7. John has 60 marbles and Will has 25 % more. How many has Will?

8. One automobile travels at the rate of 30 miles an hour and another 80 % as fast. What is the rate of the second?

9. Max sold 72 newspapers on Thursday and $12\frac{1}{2}$ % more on Friday. How many did he sell on Friday?

10. Ellen bought 12 yards of cloth. She used $66\frac{2}{3}$ % of it in making a dress. How many yards did she use?

11. Mr. Morris gathered 12 bushels of tomatoes from his vines. He sold 50 % of them to the grocer, 25 % of them to neighbors, and kept the rest for his own use. How many bushels did he keep?

PROBLEMS

Written

1. Mr. Howes had a farm of 128 acres. He sold 75 per cent of it. How many acres did he sell?

Study these three solutions:

(1) 128

.75

96.00

To find 75 % of a number is to find .75 of it; that is, to multiply the number by .75.

(2) 1.28

$\frac{75}{96.00}$

1 % of 128 is 1.28. 75 % of 128 is 75 times 1.28, or 96.

(3) 4)128

32

3

96

75 % = .75 = $\frac{75}{100} = \frac{3}{4}$. $\frac{3}{4}$ of 128 = 96.

2. Seventy-five per cent of a park of 48 acres was made into a playground. What was the area of the playground?

3. A suit of clothes cost \$18. A pair of shoes cost 15 per cent as much. How much did the shoes cost?

4. Twenty per cent of the 180 geographies in a school are worn out. How many new ones must be bought to take their place?

5. Mrs. Adams bought a 56-pound tub of butter at 25 cents a pound. 8 per cent of the butter spoiled. What was the money loss?

6. Mr. Harrow raised 144 bushels of turnips. He sold 25 per cent of them. How many bushels did he sell?

7. Mr. Francis had 144 acres in his farm. He sold 27 per cent of them. How many did he sell?

8. Of the 450 pupils in a school 42 per cent are boys. What per cent are girls? How many girls in the school?

9. To reduce his stock, a merchant makes these reductions:

ARTICLE	REGULAR PRICE	REDUCTION	ARTICLE	REGULAR PRICE	REDUCTION
Sleds	\$1.50	10 %	Skates	\$1.40	15 %
Dolls	.88	25 %	Doll Carriages	1.38	16 $\frac{2}{3}$ %
Games	.40	12 $\frac{1}{2}$ %	Magic Lanterns	2.00	37 $\frac{1}{2}$ %
Carts	2.70	30 %	Toy Engines	1.80	50 %
Knives	.85	20 %	Picture Puzzles	.75	33 $\frac{1}{3}$ %

(1) How much is taken off the regular price on each article?

(2) What is the sale price of each article?

FINDING WHAT PER CENT ONE NUMBER IS OF ANOTHER

Oral and Written

1. What part of 100 is 1? 3? 7? 19? 33?
2. How many hundredths of 100 is 9? 13? 27?
3. What per cent of 100 is 5? 8? 25? 45? 50?
4. What part of 20 is 5? How many hundredths of 20 is 5? What per cent of 20 is 5?
5. What part of 20 is 15? How many hundredths? What per cent?
6. What per cent of \$10 is \$1? \$2? \$3? \$4? \$5? \$6? \$7? \$8? \$9? \$10?
7. What part of a dozen oranges is 6 oranges? Express the answer (1) as a common fraction, (2) as a decimal, and (3) as a per cent.
8. What per cent of a gallon is 1 qt.? 2 qt.? 3 qt.? 4 qt.?
9. What per cent of a gallon is 1 pt.? 3 pt.? 2 qt. 1 pt.? $3\frac{1}{2}$ qt.?
10. What per cent of a foot is:
2 inches? 3 inches? 4 inches? 6 inches?
8 inches? 9 inches? 10 inches? 12 inches?
11. What per cent of a day is represented by:
3 hours? 4 hours? 6 hours? 8 hours?
9 hours? 12 hours? 15 hours? 16 hours?
18 hours? 20 hours? 21 hours? 24 hours?

Tell what per cent of:

- | | | | |
|--------------|--------------|--------------|--------------|
| 12. 14 is 7 | 13. 12 is 4 | 14. 30 is 6 | 15. 40 is 5 |
| 16. 36 is 9 | 17. 60 is 6 | 18. 48 is 8 | 19. 16 is 6 |
| 20. 24 is 24 | 21. 24 is 16 | 22. 27 is 18 | 23. 60 is 15 |
| 24. 40 is 16 | 25. 20 is 12 | 26. 27 is 27 | 27. 27 is 18 |
| 28. 60 is 48 | 29. 32 is 20 | 30. 56 is 49 | 31. 30 is 9 |
| 32. 40 is 36 | 33. 60 is 42 | 34. 36 is 30 | 35. 40 is 40 |

36. Express as per cents of an hour:

- | | |
|--|----------------------|
| (1) 60 min. | (2) 15 min.; 45 min. |
| (3) 30 min. | (4) 20 min.; 40 min. |
| (5) 3 min. | (6) 10 min.; 50 min. |
| (7) 12 min.; 18 min.; 36 min.; 48 min. | |
| (8) 6 min.; 18 min.; 42 min.; 54 min. | |
| (9) 9 min.; 21 min.; 27 min.; 51 min. | |

PROBLEMS

Oral

1. Two boys mowed a lawn for 40 cents. They shared the gain equally. What per cent of the pay did each get?

2. Two men plowed a field. One plowed $\frac{1}{4}$ of it and the other $\frac{3}{4}$. What per cent of the pay should each receive?

3. James is 3 years old. Robert is 15 years old. What per cent of Robert's age is James's age?

4. Clarence collected \$20 for a newspaper company. They paid him \$2. This was what per cent of the money collected?

5. Blanche solved 8 of the 10 examples given to the class. What per cent?

6. Four boys hoed a patch of potatoes. Albert worked 4 hours, Sam 3 hours, Ernest 2 hours, and Max 1 hour. What per cent of the work did each do?

7. The 40 pupils in an evening school are engaged as follows: 4 are studying drawing, 6 stenography, 8 type-writing, 10 manual training, and 12 grammar. What per cent of the pupils are engaged in each study?

8. Frances earned \$25. She bought a dress for \$12, a hat for \$4, a pair of shoes for \$3, and put \$6 in the bank. What per cent of her \$25 did she pay for each article? What per cent of her earnings did she save?

9. The Washington, Hamilton, Jefferson, and Lincoln schools played a series of ball games. Of the twelve games played by each club the Washingtons won 4, the Hamiltons 6, the Jeffersons 9, and the Lincolns 5. Express the standing of each club as a per cent.

PROBLEMS

Written

1. Mr. Billings sold 21 of the 56 bushels of corn that he raised. What part of his crop did he sell? What per cent?

Study these solutions:

$$(1) \frac{21}{56} = \frac{3}{8} = .37\frac{1}{2} = 37\frac{1}{2}\%$$

$$.375 = .37\frac{1}{2} = 37\frac{1}{2}\%$$

$$(2) 56 \overline{)21.000}$$

X 2. A farmer had 75 sheep and sold 36 of them. What per cent of his flock did he sell?

X 3. Eighteen of the 120 trees in a wood lot were cut down. This was what per cent of the whole number?

† 4. Of the 150 people on a picnic, 90 are children. The children are what per cent of the party?

† 5. Of the 400 pupils in a school, 250 are girls. The girls are what per cent of the pupils in the school?

† 6. \$16 is what per cent of \$80? \$160 is what per cent of \$800? \$1600 is what per cent of \$8000?

† 7. Mr. Maxwell sold 48 acres of his 120-acre farm. What per cent of his farm did he sell?

× 8. If a man owes \$360, and has \$270, what per cent of his debts can he pay?

✓ 9. A farmer raised 240 bushels of potatoes in one field and 360 bushels in another. What per cent of the whole crop did he raise in the first field? In the second?

✓ 10. In one season Mr. Martin raised 600 quarts of strawberries. He sold 210 quarts in town and shipped the rest to the city. What per cent did he sell in town? What per cent did he ship to the city?

✓ 11. A clerk with a salary of \$1200 saves \$300. What per cent of his salary does he save?

† 12. If a man earns \$1500 and spends \$1200, what per cent of his money does he save?

† 13. Mr. Clark built a house for \$2400. He rents it for \$240 a year. What per cent of the cost of the house is the yearly rent?

14. Mr. Blake built a house for \$2400 which he rents for \$25 a month. What per cent of the cost of the house is the yearly rent?

15. What per cent of a mile is a street 128 rods long?

WRITTEN PROBLEMS

- + 1. A farmer sold 35 pecks of peas in one week and 40% as many in the following week. How many pecks in the second week? In both weeks?
- + 2. Out of a case of 4 dozen jars of fruit $\frac{1}{2}$ of a dozen jars were broken. What per cent of the lot was salable?
- + 3. A bicycle that cost \$15.75 was sold for 68% of its cost. How much was received for it?
- + 4. Twenty-five per cent of a man's salary of \$1200 is spent for food. How much is spent for food?
- + 5. The carpenter made me a table. He charged \$5.75 for materials and \$6.25 for labor. I sold the table for \$18. What per cent of the cost did I gain?
- + 6. A house that cost \$2750 was sold for 18% less than the cost. How much was received for it?
- + 7. A merchant sold 16 tons of wheat in May and 85% as much in June. How many tons in June?
- + 8. Two hundred cases of eggs were bought at \$9 a case and sold at a gain of 20%. How much was gained?
- + 9. A piece of silk containing 48 yards and costing \$2.50 a yard was sold at a gain of 22%. What was the gain?
- + 10. Mr. Parsons bought a horse for \$150. After keeping it 10 weeks at a cost of \$5 a week, he sold it at a gain of 10% of the entire cost. How much did he gain? What was the selling price?
- + 11. Out of 350 bushels of tomatoes, 280 bushels were sold. What per cent was sold?

DIFFERENCE IN TIME BETWEEN DATES

1. Name the months of the year. How many?
2. Name the first month; the fourth; the seventh; the tenth.
3. What name is given to the second month? The fifth? The eighth? The eleventh?
4. What is the third month? The sixth? The ninth? The twelfth?
5. What month of the year is March? November? July? May?
6. How many years, months, and days from Sept. 20, 1906, to April 15, 1910?

First Method :

YEARS	MONTHS	DAYS
1910	4	15
1906	9	20
8	6	25

The minuend is the 1910th year, the 4th month, the 15th day. The subtrahend is the 1906th year, the 9th month, the 20th day.

Since we cannot take 20 days from 15 days, we take 1 of the 4 months, express it as 30 days, and put it with the 15 days, making 45 days. 20 days from 45 days leaves 25 days.

Since 9 months cannot be taken from 3 months, we take 1 of the 1910 years, or 12 months, and add it to the 3 months, making 15 months. 9 months from 15 months leaves 6 months.

1906 years from 1909 years leaves 3 years.

From Sept. 20, 1906, to April 15, 1910, is 3 years 6 months 25 days.

In finding the difference in time between two dates in this way, a month is regarded as 30 days.

Second Method :

From Sept. 20, 1906, to Sept. 20, 1909, is 3 years.

From Sept. 20, 1909, to March 20, 1910, is 6 months.

From March 20, 1910, to April 15, 1910, is 26 days.

From Sept. 20, 1906, to April 15, 1910, is 3 years 6 months 26 days.

This method is used when the exact number of days less than a month is required.

TO THE TEACHER: Teach the method in general use among business men in your locality.

Find the difference in time in years, months, and days:

7. From Nov. 17, 1900, to May 30, 1904.
8. From July 20, 1906, to Dec. 25, 1909.
9. From Aug. 6, 1903, to Jan. 1, 1908.
10. From May 24, 1907, to April 3, 1910.
11. From Sept. 12, 1905, to July 7, 1907.
- X 12. The battle of Concord and Lexington occurred April 19, 1775. Cornwallis surrendered at Yorktown Oct. 19, 1781. What was the difference in time between these events?
- X 13. Washington was born Feb. 22, 1732, and became President April 30, 1789. How old was he when inaugurated?
- X 14. Jackson fought the battle of New Orleans, Jan. 15, 1815. He became President March 4, 1827. How long after the battle?
- X 15. The colonies declared their independence July 4, 1776. How long ago?

X 16. Daniel Webster was born Jan. 18, 1782. How old was he at the time of his famous speech in the Senate, March 7, 1850?

X 17. Nellie was born Nov. 17, 1905, and entered the kindergarten Sept. 9, 1910. At what age?

X 18. How old is a boy who was born May 12, 1898?

X 19. What is your age in years, months, and days?

Find the difference in time in years, months, and days between these events and today:

20. The landing of the Pilgrims, Dec. 20, 1620.

21. The discovery of America by Columbus, Oct. 12, 1492.

22. The Treaty of Peace at the close of the Revolutionary war, Sept. 3, 1783.

23. The Battle of Bunker Hill, June 17, 1775.

24. The first message by telegraph, May 24, 1844.

25. The birth of Lincoln, Feb. 12, 1809.

INTEREST

Oral

Mr. Mason has an automobile worth \$3000. He lets me have the use of it one hour for \$5.

Mr. Harrison has a house worth \$3000. He lets me have the use of it one year for \$300.

If Mr. Mason or Mr. Harrison should let me have the use of \$3000 for a year, would he expect me to pay for the use of it?

Whenever one person has the use of another person's property—his automobile, his house, his money—he pays him for it.

Mr. Ellis let me have \$100 for a year. At the end of the year I paid him 6% of \$100, or \$6, for the use of it.

Money paid for the use of money is *interest*.

The money on which interest is paid is the *principal*.

The per cent of the principal paid each year for interest is the *rate of interest*.

1. What is the interest of \$100 for 1 year at 3%? At 4%? At 5%? At 7%? At 8%? At 10%?

2. At 5%, how much must be paid for the use of \$200 for 1 year? 2 years? 4 years? 5 years?

Find the interest for 1 year on:

Written

- | | | |
|-----------------|-----------------|-----------------|
| 3. \$50 at 4% | 4. \$60 at 6% | 5. \$80 at 3% |
| 6. \$200 at 5% | 7. \$400 at 8% | 8. \$600 at 7% |
| 9. \$300 at 7% | 10. \$500 at 4% | 11. \$700 at 5% |
| 12. \$800 at 6% | 13. \$900 at 5% | 14. \$900 at 8% |

At 4%, what is the interest on:

- | | | | |
|-----------------------------------|---------------------|---------------------|---------------------|
| 15. \$200 for 1 yr.? | $1\frac{1}{2}$ yr.? | $1\frac{1}{4}$ yr.? | $1\frac{3}{4}$ yr.? |
| 16. \$300 for 1 yr.? | $1\frac{1}{3}$ yr.? | $1\frac{2}{3}$ yr.? | $2\frac{1}{3}$ yr.? |
| 17. \$400 for $1\frac{1}{8}$ yr.? | $1\frac{5}{8}$ yr.? | $2\frac{1}{8}$ yr.? | $2\frac{3}{4}$ yr.? |

18. What part of a year is 6 months? 3 months? 9 months? 4 months? 8 months? 2 months? 10 months? 1 month? 5 months? 7 months? 11 months?

19. At 4% a year, what part of a year's interest ought to be paid for the use of \$300 for 3 months? What interest should be paid?

At 6%, what is the interest on:

- | | |
|-------------------------------------|--------------------------|
| 20. \$800 for 3 months? | 21. \$700 for 2 months? |
| 22. \$500 for $\frac{1}{2}$ months? | 23. \$400 for 10 months? |
| 24. \$300 for 8 months? | 25. \$400 for 7 months? |

Find the interest on :

- + 26. \$50 at 4% for 1 year 6 months.
 + 27. \$600 at 4% for 1 year 7 months.
 + 28. \$80 at 5% for 2 years 3 months.
 + 29. \$600 at 6% for 2 years 1 month.
 30. What is the interest on \$132 for 2 years 7 months at 4% ?

\$132	
<u>.04</u>	The interest for 1 year
\$5.28 int. for 1 year	is 4% of \$132, or \$5.28.
<u>2 $\frac{7}{12}$</u>	The interest for 2
\$3.08 int. for $\frac{7}{12}$ of a year	years 7 months is $2\frac{7}{12}$
10.56 int. for 2 years	times \$5.28, or \$13.64.
\$13.64 int. for 2 years 7 months	

Find the interest on :

31. \$180 for 3 years at 5% ; for 2 years at 4%.
 32. \$225 for 2 years 4 months at 4%.
 33. \$420 for 3 years 3 months at 6%.
 34. \$360 for 2 years 10 months at 7%.

PRINCIPAL	TIME	RATE	INTEREST
35. \$640	2 years 5 months	3%	?
36. \$256	3 years 8 months	6%	?
37. \$576	4 years 3 months	5%	?
38. \$900	2 years 4 months	7%	?
39. \$372	1 year 1 month	4%	?
40. \$324	5 years 6 months	5%	?
41. \$456	3 years 8 months	4%	?
42. \$864	4 years 11 months	7%	?
43. \$375	2 years 9 months	6%	?
44. \$264	1 year 9 months	8%	?

45. What is the interest on \$240 at 5% from Jan. 1 to July 1?
46. How much must be paid for the use of \$600 at 7% from Sept. 1 to Jan. 1?
47. On June 1 Mr. Nichols borrowed \$225 at 6%. What interest was due Oct. 1? If Mr. Nichols paid both principal and interest Oct. 1, what *amount* did he pay?
- The sum of the principal and the interest is the *amount*.
48. On Jan. 1 Mr. Stevens bought a horse for \$150, agreeing to pay for it in 6 months with interest at 5%. When must the money be paid? How much?
49. When money is worth 7%, what must be paid to settle in full a loan of \$456 for 2 months?
50. Mr. Young bought a house for \$3000. He paid down $\frac{2}{5}$ of the price and promised to pay the rest in 4 months with interest at 5%. How much did he pay at time of settlement?

REVIEW EXERCISE

	A		B		C		D	
1.	$\frac{7}{8}$	$\frac{5}{16}$	$2\frac{1}{2}$	$\frac{2}{5}$	$4\frac{1}{8}$	$1\frac{3}{8}$	$4\frac{3}{4}$	$2\frac{3}{16}$
2.	$\frac{15}{16}$	$\frac{3}{4}$	2	$\frac{3}{4}$	$4\frac{1}{4}$	$2\frac{1}{2}$	$3\frac{3}{8}$	$3\frac{1}{8}$
3.	$\frac{3}{4}$	$\frac{1}{6}$	$2\frac{1}{4}$	$\frac{2}{3}$	$3\frac{1}{6}$	$2\frac{1}{2}$	$8\frac{2}{3}$	$6\frac{2}{3}$
4.	$\frac{5}{7}$	$\frac{1}{4}$	$4\frac{2}{5}$	$\frac{3}{5}$	$7\frac{3}{7}$	$1\frac{1}{4}$	$5\frac{2}{5}$	$1\frac{1}{5}$
5.	$\frac{5}{12}$	$\frac{2}{9}$	$2\frac{2}{3}$	$\frac{8}{9}$	$6\frac{1}{4}$	$1\frac{1}{8}$	$6\frac{5}{8}$	$2\frac{1}{8}$
6.	$\frac{5}{8}$	$\frac{4}{7}$	$3\frac{1}{2}$	$\frac{6}{7}$	$5\frac{1}{8}$	$1\frac{1}{9}$	$8\frac{3}{4}$	$3\frac{2}{3}$
7.	$\frac{21}{40}$	$\frac{3}{8}$	$3\frac{1}{8}$	$\frac{9}{10}$	$8\frac{2}{5}$	$6\frac{1}{7}$	$7\frac{2}{5}$	$2\frac{1}{4}$
8.	$\frac{3}{4}$	$\frac{8}{15}$	$5\frac{4}{9}$	$\frac{5}{8}$	$2\frac{5}{8}$	$1\frac{1}{4}$	$9\frac{3}{8}$	$8\frac{1}{8}$
9.	$\frac{6}{7}$	$\frac{5}{6}$	$4\frac{3}{8}$	$\frac{5}{7}$	$3\frac{3}{4}$	$2\frac{1}{6}$	$5\frac{7}{12}$	$2\frac{4}{15}$
10.	$\frac{7}{15}$	$\frac{3}{20}$	$8\frac{5}{9}$	$\frac{7}{9}$	$2\frac{3}{8}$	$1\frac{7}{12}$	$7\frac{2}{7}$	$2\frac{1}{8}$

1. Add the numbers in each couplet.
2. Subtract the second term of each couplet from the first term.
3. Find the product of the terms in each couplet.
4. Divide the first term of each couplet by the second term.
5. Divide the second term of each couplet by the first term.
6. Make up problems based on the combinations in the table.

MISCELLANEOUS PROBLEMS

1. The rainfall in a city in one year was as follows:

January,	3.386 in.	(1) What was the total rainfall
February,	3.957 in.	for the year?
March,	5.900 in.	(2) What was the average rain-
April,	5.691 in.	fall per month?
May,	0.818 in.	(3) How much more rain fell
June,	9.180 in.	in June than in July?
July,	2.621 in.	(4) How much more rain fell in
August,	3.676 in.	the first half of the year than in
September,	1.745 in.	the last half of the year?
October,	4.461 in.	(5) What amount fell in the
November,	1.527 in.	three months of least rainfall?
December,	3.011 in.	In the three months of greatest
		rainfall?

2. Four and one half acres of land were cut up into 24 house lots. What part of an acre was each lot?

3. Mr. Mason paid \$240 for a carriage and sold it for 80% of what he paid. For how much did he sell it?

X4. What per cent of the cost is loss when hay is bought at \$20 a ton and sold at \$18 a ton?

X5. The area of Alaska is about 600,000 square miles. We paid Russia \$7,200,000 for it. How much per square mile? Per acre?

X6. A man spends $\frac{7}{8}$ of his salary, and saves \$280. What is his salary?

X7. A earns \$2 $\frac{1}{2}$ per day, and spends \$1 $\frac{3}{4}$. How many days must he work to save \$100?

X8. A man owing a debt of \$280 paid 40% of it at one time, and 50% of the remainder at another time. How much did he still owe?

X9. How many articles, at the following rates, can be purchased with a \$5 bill: 12 $\frac{1}{2}$ ¢? 16 $\frac{2}{3}$ ¢? 50¢? 33 $\frac{1}{3}$ ¢? 8 $\frac{1}{3}$ ¢? 6 $\frac{1}{2}$ ¢? 25¢? 3 $\frac{1}{4}$ ¢? 6 $\frac{3}{4}$ ¢?

X10. How many yards of ribbon at 12 $\frac{1}{2}$ ¢ a yard are equal in value to 24 yards worth 33 $\frac{1}{3}$ ¢ a yard?

X11. A fruit dealer bought a box of oranges for \$2.50. He sold them for \$3.50. What part of the cost did he gain? What per cent?

X12. Add the quotients of $.1152 \div 12$ and $11.52 \div 12$.

X13. Find the difference between the quotient of $.012 \div 4$ and the product of $.012 \times 4$.

X14. Multiply the quotient of $.08 \div 4$ by the sum of 2.12 and .88.

X15. Divide the sum of 2.2 and .2 by their difference.

X16. Mr. Hodge's bill for 15 days' work in making a farmer's wagon was \$35.25. How much did he charge per day?

X 17. The freight charge between two places is 58 cents per hundred pounds. What is the charge for shipping 20 barrels of oil, each weighing 310 pounds?

X 18. A Kansas farmer bought 80 acres of cheap land for \$240. Oil being found on his farm, he sold his land for \$60,000. What was his profit? How much did the land cost per acre? For how much was it sold per acre?

+ 19. A grocer bought 210 pounds of tea for \$100.80, and sold the lot for \$117.60. What was the gain per pound?

X 20. At another time he bought 87 pounds for \$46.11. He sold this at a gain of 6 cents a pound. How much did he receive for the lot?

+ 21. One hundred fifty pounds of butter cost \$49.50. It was sold at 38 cents a pound. What was the gain?

X 22. A field 120 rods by 40 rods produced $28\frac{1}{2}$ bushels of wheat to the acre. What was the crop worth at 92 cents a bushel?

April 2
X 23. A dealer mixed 6 pounds of coffee costing 24 cents a pound and 12 pounds costing 30 cents a pound. What was the value of one pound of the mixture?

X 24. Mr. Burns sold to Mr. Dean 36 acres of land at \$50 an acre. Mr. Dean gave in payment \$639 in money and a city house lot. What was the value of the house lot?

X 25. Mr. Cushing raised 440 bushels of potatoes. Sixty-five bushels were unmarketable. He sold the rest at 75 cents a bushel. How much did he receive?

X 26. What is the gain on 36 bunches of bananas bought at \$1.37 each and sold at \$1.95 each?

27. A merchant bought eggs at 32 cents a dozen and sold them at 40 cents a dozen. His gain was \$2.16. How many dozen did he buy and sell?

28. A merchant made \$9.88 by buying roasting pans at 37 cents each and selling at 50 cents each. How many did he buy and sell?

29. Bronze is composed of 18 parts copper, 1 part tin, 1 part zinc.

(1) What per cent of each metal is used?

(2) How many pounds of each metal in a bronze statue weighing 2000 pounds?

30. In 3.2 hours a man walks 12.32 miles. How far does he walk in one hour?

31. If a man can walk 3.2 miles in one hour, how many miles can he walk in 12.32 hours?

32. If you ride your wheel for an hour at the rate of 12.32 miles per hour, how many miles have you to ride after going 3.2 miles?

33. John rode his wheel 12.32 miles on Tuesday and 3.2 miles on Wednesday. How far did he ride on both days?

34. On Thursday he rode 12.32 miles, and on Friday 3.2 miles more than on Thursday. How far did he ride on both days?

35. What per cent of the cost is the gain when flour is bought for \$6 a barrel and sold for \$7 a barrel?

36. What is the gain per cent in buying flour at \$6.00 a barrel and selling at \$7.50 a barrel?

37. If a man sells $\frac{1}{4}$ of his farm of 175 acres, how many acres has he left?

38. What is the greatest number that will divide all of these numbers, — 108, 144, and 168?

39. A workman receives \$15.75 per week. He spends \$3.25 for rent, \$3.15 for groceries, \$3.70 for provisions, \$2.37 for clothing, \$0.63 for luxuries, and deposits \$2 in the bank. How much has he left?

40. At \$75 per acre, what is the value of a lot of land 65 rods by 48 rods?

41. Four boys go camping for a week. They pay 50¢ a day for their tent, \$1.60 a day for their living, 50¢ a day for their boat, and each pays 75¢ for car fare. How much did each pay for his outing?

42. Mr. Arthur R. Bean rents a house to Mr. Charles L. Roper for \$18 a month. Make out a receipt for rent received for the month of July, 1912.

43. On April 10, 1911, Mrs. A. M. Baker buys the following goods from Gardner and Bassett: $3\frac{1}{2}$ yd. lawn at 20¢ a yard, 3 yd. table damask at \$1.25 a yard, and $1\frac{1}{2}$ doz. towels at $12\frac{1}{2}$ ¢ each. Make out her bill.

44. The stripes of the flag on the schoolhouse are $2\frac{3}{4}$ inches wide. What is the width of the flag?

45. A piece of cardboard 12 in. square is cut into pieces 3 in. by $1\frac{1}{2}$ in. How many?

46. A house lot is 68 ft. long and $\frac{3}{4}$ as wide. What is its perimeter?

47. A club bought 20 baseballs, paying at the rate of \$15 a dozen. How much?

48. What are the prime factors of 168?

49. Change $\frac{84}{216}$ to lowest terms.

CROPS RAISED BY A STATE SCHOOL *Written*

A state school raised the following crops on its farm. Find the value of each crop at the given rate. (Keep answers.)

CROP	QUANTITY	MARKET RATE
1. Apples	1,124 barrels	\$1.95 per bbl.
2. Beets	1,373 bushels	50¢ per bu.
3. Cabbage	54,396 pounds	1¢ per lb.
4. Carrots	1,660 bushels	45¢ per bu..
5. Corn (ensilage)	545 tons	\$12.50 per T.
6. Corn (fodder)	147 tons	\$10.25 per T.
7. Corn (green)	302 bushels	55¢ per bu.
8. Cucumbers	110 boxes	\$5 per box
9. Lettuce	194 boxes	40¢ per box
10. Onions	408 bushels	75¢ per bu.
11. Potatoes	9,659 bushels	67¢ per bu.
12. Pumpkin	17,028 pounds	$\frac{1}{2}$ ¢ per lb.
13. Rhubarb	2,948 pounds	$2\frac{1}{2}$ ¢ per lb.
14. Squash (summer)	94 barrels	70¢ per bbl.
15. Squash (winter)	20 tons	1¢ per lb.
16. Tomatoes (green)	120 bushels	40¢ per bu.
17. Tomatoes (ripe)	92 bushels	60¢ per bu.
18. Turnips	768 barrels	\$1.15 per bbl.

Find the total market value of the crops.

PART II

ADVANCED ARITHMETIC

NOTATION AND NUMERATION

1. In our system of writing numbers, how many units of one order are required to make one unit of the next higher order?

2. What name is given to such a system of notation?

3. How many places are required to write ten in figures? One thousand? One million?

Using the symbols 4, 6, 8, 3, 2, write :

4. The largest number possible. Read it.

5. The smallest number possible. Read it.

Separate into groups, read aloud, and then write in words :

6. 507

7. 8700

8. 90376

9. 299000

10. 54000

11. 50040

12. 7068

13. 18043

14. 6073

15. 600708

16. 70007

17. 6007

18. 4061295

19. 9007005

20. 123456789

21. 870642083

Read :

22. The quantity of peanuts exported from the United States in one year was : to Oceania, 789 pounds ; to Asia, 1100 pounds ; to Africa, 66,443 pounds ; to South America, 334,992 ; to Europe, 1,497,625 pounds ; to North America, 3,600,158 pounds.

38. Clarence has a foreign coin stamped MDCCLXX. In what year was it minted?

39. On the corner stone of a public library are these letters — MDCCCXCII. When was the corner stone laid?

40. The seal of a celebrated boys' school bears the letters MDCCLXVIII. When was the school founded?

41. A monument commemorating the landing of the Pilgrims bears these dates: MDCXX
MCMX The upper date tells when the Pilgrims landed; the lower, when the monument was dedicated. Write both dates in figures.

42. Write in letters the two dates which should be inscribed on a tablet commemorating the birth of Washington (1732) and the 200th anniversary of his birth.

43. Write (1) in words; (2) in figures; (3) in letters:

Your age; your grade in school; the number of your schoolroom; the number of pupils in the room; this page of the book; the number of pages in the book; the present month of the year; the day of the month; the present year; the street number of your house; the year in which you were born.

DICTATION EXERCISES

1. $64 \div 8, \times 3, + 11, \div 7, - 2, \times 9, + 6, \div 3, \times 5.$
2. $12 \times 9, + 2, \div 11, \times 4, - 8, \times 2, - 8, + 7, \times 5, + 15.$
3. $7 + 6, - 3, \times 7, + 2, \div 8, - 3, \times 6, + 4, \div 10, - 4.$
4. $12 \times 7, - 9, \div 5, + 6, \div 7, \times 13, + 3, \div 6, + 4, \times 3.$
5. $108 \div 9, + 8, - 4, \times 6, \div 8, + 8, - 5, \times 3, \div 9, + 5.$
6. $64 \div 4, - 2, \times 2, \div 4, + 4, \times 8, - 4, \div 7, - 6, \times 0.$

NOTE. Similar dictations should be given daily.

ADDING TWO COLUMNS AT ONCE

Find the sum, adding both columns at once; test the work:

1. 37	2. 56	3. 28	4. 43	5. 54	6. 72
7	8	9	9	7	8
14	4	5	8	5	3
6	13	3	7	6	4
3	5	2	25	5	2
28	8	17	3	9	17
5	29	5	2	22	6
9	7	26	16	7	35
2	4	8	4	6	8
2	3	4	1	15	2
<u>3</u>	<u>2</u>	<u>1</u>	<u>4</u>	<u>5</u>	<u>3</u>

7. 11	8. 15	9. 7	10. 8	11. 10	12. 6
5	4	3	5	7	12
6	7	12	40	6	7
10	2	8	2	25	20
3	20	34	4	2	10
22	8	9	29	3	5
7	3	6	7	37	42
12	11	20	18	1	8
9	7	7	3	8	3
5	2	14	11	5	27
<u>4</u>	<u>5</u>	<u>6</u>	<u>8</u>	<u>7</u>	<u>2</u>

Beginning with 25, or any given number, add the numbers in examples 1 to 12.

NOTE. Drill in this form of addition should be given frequently until pupils become proficient.

DRILL TABLE: FUNDAMENTAL PROCESSES

	A	B	C	D	E	F	G	H
1.	144	128	190	178	135	108	125	162
2.	138	191	127	107	179	136	106	156
3.	192	126	137	173	145	180	157	124
4.	129	193	174	130	104	158	181	146
5.	163	109	194	142	159	147	105	182
6.	131	175	155	199	103	134	183	123
7.	176	110	164	132	198	184	154	161
8.	143	133	148	165	185	197	122	153
9.	111	170	113	186	166	121	196	115
10.	149	112	187	140	152	167	116	195
11.	160	188	119	172	139	150	168	141
12.	189	118	151	117	120	171	114	169

EXERCISES IN ADDITION

To each number in the table add 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12.

To each number add 10; 20; 30; 40; 50; 60; 70; 80; 90; 110; 120.

Give the sum of each number in the table and 79. Thus, $144 + 79$; $144 + 70 + 9$; think 214, 223; say 223.

Add other numbers to the numbers in the table.

Find the sum of column A. Of the other columns.

Find the sum of row 1. Of the other rows.

EXERCISES IN SUBTRACTION

From the numbers in the drill table take 2; 4; 6; 8; 1; 3; 5; 7; 9.

Subtract each number in the drill table from 200; from 500; from 800.

Take 69 from each number in the drill table. Thus, $144 - 69 = 144 - 60 - 9$; think 84, 75; say 75.

Find the difference between other numbers and the numbers in the drill table.

1. From 865 take 376.
2. Take 589 from 706.
3. From 407 take 69.
4. Take 418 from 724.
5. From 5000 take 976.
6. Take 1987 from 5086.
7. From 4652 take 848.
8. Take 1695 from 4763.
9. From 8507 take 3698.
10. Take 6007 from 70,006.
11. From 65,089 take 9999.
12. Take 40,004 from 90,000.
13. From 60,057 take 39,068.
14. Take 9728 from 69,573.
15. From 46,008 take 17,439.
16. Take 80,668 from 861,547.
17. From 700,000 take 365,746.
18. Take 23,994 from 470,083.
19. From 248,576 take 150,798.
20. Take 476,059 from 826,045.

EXERCISES IN MULTIPLICATION

Multiply (orally) each number in the drill table on page 146 by 2;
3; 4; 5; 6; 7; 8; 9.

Multiply :

- | | |
|------------------|-------------------|
| 1. 65 by 47 | 2. 83 by 96 |
| 3. 70 by 68 | 4. 94 by 57 |
| 5. 76 by 86 | 6. 573 by 64 |
| 7. 609 by 97 | 8. 863 by 168 |
| 9. 705 by 308 | 10. 965 by 86 |
| 11. 867 by 397 | 12. 905 by 96 |
| 13. 4809 by 73 | 14. 6000 by 705 |
| 15. 3456 by 98 | 16. 7008 by 807 |
| 17. 4365 by 1729 | 18. 9046 by 378 |
| 19. 49,308 by 67 | 20. 38,067 by 209 |

- | | |
|-----------------------|-----------------------|
| 21. 86,297 by 56 | 22. 73,009 by 2376 |
| 23. 96,580 by 374 | 24. 63,084 by 1708 |
| 25. 46,376 by 7236 | 26. 56,473 by 476 |
| 27. 743,618 by 97 | 28. 360,874 by 365 |
| 29. 426,083 by 25,007 | 30. 367,589 by 24,387 |

EXERCISES IN DIVISION

Divide (orally) the numbers in the drill table on page 146 by 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12.

I. Divide (short division) each dividend in the examples below by 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12.

II. Divide :

- | | |
|----------------------|-----------------------|
| 1. 638 by 47 | 2. 809 by 38 |
| 3. 793 by 67 | 4. 985 by 73 |
| 5. 807 by 96 | 6. 986 by 463 |
| 7. 879 by 164 | 8. 6844 by 97 |
| 9. 4009 by 73 | 10. 3967 by 289 |
| 11. 4368 by 48 | 12. 6840 by 375 |
| 13. 9000 by 173 | 14. 4738 by 294 |
| 15. 36,900 by 75 | 16. 67,857 by 89 |
| 17. 37,008 by 96 | 18. 65,078 by 359 |
| 19. 39,872 by 623 | 20. 46,798 by 604 |
| 21. 84,376 by 356 | 22. 730,657 by 73 |
| 23. 496,320 by 475 | 24. 327,009 by 764 |
| 25. 510,936 by 732 | 26. 460,738 by 326 |
| 27. 645,170 by 866 | 28. 306,752 by 1345 |
| 29. 3,194,658 by 456 | 30. 4,073,251 by 2375 |

WRITTEN PROBLEMS

1. The number of immigrants to the United States for the year ending June 30, 1909, was as follows: Landing at Baltimore, 18,966; at Boston, 36,318; at New York, 580,617; at Philadelphia, 14,294; at San Francisco, 3103; at all other ports, 98,488. Find the total number.

2. Of the 654,875 immigrants to the United States from Europe in the same year, 170,191 came from Austria; 25,540 from Germany; 14,111 from Greece; 183,218 from Italy; 13,627 from Norway; 120,460 from Russia; 14,474 from Sweden; and 71,826 from the United Kingdom. What was the total number from these countries? What was the total number from European countries not mentioned?

3. A hardware merchant estimated the value of stock on hand January 1, at \$14,813.76. During the year he bought goods to the value of \$5817.56, and sold goods to the value of \$12,627.98. What was the value of the stock on hand December 31?

EXPORTS OF BOOTS AND SHOES FROM THE UNITED STATES
IN FIVE YEARS

EXPORTED TO	1905	1906	1907	1908	1909
	Pairs	Pairs	Pairs	Pairs	Pairs
Europe	1,149,899	1,257,004	1,215,428	1,241,649	1,235,670
North America	3,425,111	3,774,655	3,833,856	4,445,141	4,410,550
South America	206,117	197,549	229,478	266,347	229,387
Asia	42,332	47,074	35,766	40,242	30,178
Oceania	362,646	312,869	460,469	490,566	205,871
Africa	129,594	83,098	58,917	68,467	64,923

EXPORTED TO	1905	1906	1907	1908	1909
	Dollars	Dollars	Dollars	Dollars	Dollars
Europe . . .	2,472,608	2,591,144	3,062,988	3,154,107	3,021,711
North America	4,238,642	5,367,349	6,167,179	6,660,657	6,183,859
South America	325,467	363,310	458,613	548,702	474,119
Asia	77,277	80,868	54,782	85,988	67,849
Oceania . . .	673,056	552,104	792,464	850,449	408,096
Africa . . .	270,647	187,973	130,923	169,656	150,180

4. Find the total number of pairs exported in 1905; their total value.

5. Find the same facts in regard to each of the other years.

6. What was the total number of pairs exported to Europe in the five years? Their total value?

7. Find the total shipments, and their total value, to each of the other parts of the world in the five years.

8. A merchant bought 12 dozen straw hats at 28 cents apiece and sold them at 45 cents each. How much did he gain?

9. Oscar sold 18 chickens and 14 doves for \$7.30. He sold the doves at 20 cents apiece. How much did he get apiece for the chickens?

10. Mr. Spare bought from various farmers 24 cases of eggs, 30 dozen to a case, at 24 cents a dozen. He sold the lot for \$187.20. What was his profit on a dozen?

11. The vote for governor in a state election was as follows:

A. B., Democrat, received 229,352 votes; C. D., Republican, 194,173 votes; E. F., Socialist, 11,396 votes:

G. H., Prohibition, 3277 votes; I. J., Socialist Labor, 2613 votes; all others, 20 votes.

Find the total vote. By what plurality over C. D. was A. B. elected?

12. A wholesale merchant bought 360 barrels of apples at \$1.12 per barrel. After sorting them, he had 325 barrels which he sold at \$2.40 per barrel. How much did he gain?

13. The Mississippi River is 2775 miles in length and is navigable for 2429.5 miles from its mouth. For how many miles is it not navigable?

14. In going from Vicksburg, Miss., to Memphis, Tenn., a boat travels 369 miles. If Vicksburg is 362 miles above New Orleans, and Memphis is 432 miles below St. Louis, how many miles is it by water from St. Louis to New Orleans?

15. At the rate of $37\frac{1}{2}$ cents each, how much must be paid for one and a half dozen lace collars?

16. At the rate of 8 for a dollar, how many handkerchiefs can be bought for 75 cents? For $\$1\frac{1}{4}$?

17. An encyclopedia of 8 volumes bought for \$56 was sold at the rate of \$2.85 per volume. What was the loss?

18. A catch of 70,000 pounds of codfish was sold at \$3.65 per hundredweight. After deducting the expense of the trip, \$345, the balance was divided as follows: $\frac{1}{4}$ to the owners of the vessel, and the remainder equally among the crew of 21 men. What was each man's share?

19. A merchant buys neckties at the rate of 6 for a dollar and sells them for 25 cents apiece. What is the gain on a dozen?

20. A man earning \$2.56 per day of 8 hours lost $12\frac{1}{2}$ hours' time in a week. What were his wages for that week?

21. An estate worth \$23,274 was divided as follows: $\frac{1}{3}$ to the mother; and the remainder equally among 4 children. How much did the mother receive? How much did each child receive?

22. Frank raised 120 cucumbers which he sold at the rate of 2 for 5 cents. How much did he receive?

23. What is the difference in the amounts received in a year by two men, one of whom receives \$75 a month, and the other 35 cents an hour, working 8 hours a day, 308 days in the year?

24. If the average yearly expense to a city for each pupil in the kindergarten is \$27.18, in the primary school \$16.58, in the grammar school \$19.09, and in the high school \$40.68, what is the total cost of educating a child who attends the kindergarten 2 years, the primary school 3 years, the grammar school 5 years, and the high school 4 years?

25. A test of a herd of cows showed that the 5 poorest ate feed worth \$140 and returned \$143 in product, while the 5 best ate feed worth \$204 and returned \$395. What was the average profit per cow of the 5 poorest? Of the 5 best? Of the whole herd?

26. A Maine farmer raised 2100 bushels of potatoes on 7 acres of land at a cost of \$80 an acre, and sold his crop at \$1 $\frac{1}{2}$ per barrel of 2 $\frac{1}{2}$ bushels. Find the profit per acre.

27. Another farmer in Maine harvested 6000 barrels of potatoes from 50 acres at a cost of \$60 an acre, and sold them at \$1 $\frac{1}{2}$ per barrel. Find his profit per acre.

28. If the average potato yield in the United States is 100 bushels per acre, find how many times the average yield was produced per acre in problem 26; in problem 27.

29. Fruit merchants in St. Louis bought the entire apple crop — 15,760 barrels — of a town in Massachusetts at \$1.75 per barrel. How much was paid?

30. Mr. Franklin received \$300 from the sale of the crop from 25 apple trees. If the selling price was \$1.75 per barrel, what was the average yield per tree?

31. Mr. Peterson bought 28 acres of land for \$630, and another lot at the same rate per acre for \$945. How many acres in the second lot?

32. At an agricultural experiment station a flock of 63 Merino sheep was fed in 110 days 2,785 pounds of oats, 3,135 pounds of corn, 514 pounds of bran, 324 pounds of oil meal, 743 pounds of mangels, and 14,360 pounds of hay. Find the total number of pounds of feed consumed; the average number of pounds of feed consumed by each sheep; the average number of pounds of feed consumed each day.

UNITED STATES MONEY

Oral

1. How many half dollars in \$6? How many quarters? Dimes? Nickels? Cents?

2. How many half dollars in \$7.50? Quarters? Dimes? Nickels? Cents?

3. Express as dollars: 19 half dollars 25 quarters
57 dimes 63 nickels 206 cents 56 cents 7 cents

4. Inez paid a bill with dimes, nickels, and cents, using 10 dimes, one half as many nickels, and one fifth as many cents. What was the amount of the bill?

Solve :

<i>A</i>	<i>B</i>	<i>C</i>
5. \$4 - \$0.10	$4 \times \$0.10$	$\$4 + \0.10
6. \$6 - \$0.20	$6 \times \$0.20$	$\$6 + \0.20
7. \$16 - \$0.25	$16 \times \$0.25$	$\$16 + \0.25
8. \$48 - \$0.50	$48 \times \$0.50$	$\$48 + \0.50
9. \$30 - \$0.33 $\frac{1}{3}$	$30 \times \$0.33\frac{1}{3}$	$\$30 + \$0.33\frac{1}{3}$
10. \$24 - \$0.16 $\frac{2}{3}$	$24 \times \$0.16\frac{2}{3}$	$\$24 + \$0.16\frac{2}{3}$
11. \$2 - \$0.08 $\frac{1}{3}$	$2 \times \$0.08\frac{1}{3}$	$\$2 + \$0.08\frac{1}{3}$
12. \$3 - \$0.12 $\frac{1}{2}$	$3 \times \$0.12\frac{1}{2}$	$\$3 + \$0.12\frac{1}{2}$
13. \$4 - \$0.06 $\frac{1}{4}$	$4 \times \$0.06\frac{1}{4}$	$\$4 + \$0.06\frac{1}{4}$

Make up problems based on the above exercise.

PURCHASES AT THE MARKET

Oral

Find the cost of :

1. 2
- $\frac{1}{2}$
- lb. lamb @ 15¢.

2 $\frac{1}{2}$ times 15¢ = 37 $\frac{1}{2}$ ¢. When the amount of a purchase contains a fraction of a cent equal to $\frac{1}{2}$, the next full cent is charged. The purchaser in this case would pay 38 cents.

- | | |
|--|---------------------------------------|
| 2. 1 $\frac{1}{2}$ lb. sausage @ 17¢ | 3. 6 $\frac{1}{2}$ lb. beef @ 23¢ |
| 4. 2 $\frac{1}{4}$ lb. ham @ 23¢ | 5. 3 $\frac{1}{2}$ lb. veal @ 19¢ |
| 6. 1 $\frac{3}{4}$ lb. steak @ 30¢ | 7. 1 $\frac{1}{2}$ lb. haddock @ 11¢ |
| 8. 2 $\frac{1}{2}$ lb. bluefish @ 17¢ | 9. 1 $\frac{1}{2}$ lb. bacon @ 25¢ |
| 10. 3 $\frac{3}{8}$ lb. chicken @ 28¢ | 11. 6 $\frac{1}{2}$ lb. tomatoes @ 5¢ |
| 12. 2 $\frac{1}{2}$ doz. oranges @ 25¢ | 13. 1 $\frac{1}{2}$ pk. apples @ 37¢ |
| 14. 2 $\frac{1}{2}$ doz. eggs @ 35¢ | 15. 1 $\frac{3}{4}$ doz. lemons @ 25¢ |
| 16. 2 $\frac{1}{4}$ lb. tongue @ 23¢ | 17. 2 $\frac{3}{4}$ lb. lobster @ 25¢ |
| 18. 1 $\frac{1}{4}$ lb. dried beef @ 15¢ | 19. 4 $\frac{1}{2}$ lb. mutton @ 17¢ |
| 20. 1 $\frac{1}{2}$ lb. carrots @ 3¢ | 21. 2 $\frac{1}{4}$ lb. parsnips @ 3¢ |

SHORT METHODS OF MULTIPLYING

1. Find the cost of 328 yards of muslin at 25 cents a yard.

SOLUTION. At \$1 a yard the cost would be \$328. At 25 cents a yard the cost will be $\frac{1}{4}$ of \$328, or \$82.

In the following problems use pencil only in writing the cost of each quantity and the total cost.

Find the total cost of:

- | | |
|---------------------------------|---------------------------------|
| 2. 325 lb. @ 10 ¢ | 3. 148 lb. @ 50 ¢ |
| 600 lb. @ 25 ¢ | 360 lb. @ $33\frac{1}{3}$ ¢ |
| 240 lb. @ $12\frac{1}{2}$ ¢ | 246 lb. @ $16\frac{2}{3}$ ¢ |
| 640 lb. @ $6\frac{1}{4}$ ¢ | 480 lb. @ $8\frac{1}{3}$ ¢ |
| 4. 25 yd. @ 20 ¢ | 5. 145 yd. @ 10 ¢ |
| 60 yd. @ 40 ¢ | 240 yd. @ 30 ¢ |
| 45 yd. @ 60 ¢ | 150 yd. @ 70 ¢ |
| 75 yd. @ 80 ¢ | 120 yd. @ 90 ¢ |
| 6. 216 doz. @ $33\frac{1}{3}$ ¢ | 7. 320 doz. @ $12\frac{1}{2}$ ¢ |
| 360 doz. @ $66\frac{2}{3}$ ¢ | 560 doz. @ $37\frac{1}{2}$ ¢ |
| 108 doz. @ $16\frac{2}{3}$ ¢ | 640 doz. @ $62\frac{1}{2}$ ¢ |
| 120 doz. @ $83\frac{1}{3}$ ¢ | 720 doz. @ $87\frac{1}{2}$ ¢ |
| 8. 60 yd. @ $3\frac{1}{3}$ ¢ | 9. 56 yd. @ $12\frac{1}{2}$ ¢ |
| 80 yd. @ $2\frac{1}{2}$ ¢ | 96 yd. @ $33\frac{1}{3}$ ¢ |
| 64 yd. @ $6\frac{1}{4}$ ¢ | 84 yd. @ $8\frac{1}{3}$ ¢ |
| 72 yd. @ $8\frac{1}{3}$ ¢ | 45 yd. @ 40 ¢ |
| 10. 15 yd. @ 50 ¢ | 11. 80 yd. @ 60 ¢ |
| 25 yd. @ 25 ¢ | 72 yd. @ $83\frac{1}{3}$ ¢ |
| 10 yd. @ 75 ¢ | 72 yd. @ $37\frac{1}{2}$ ¢ |
| 40 yd. @ $62\frac{1}{2}$ ¢ | 36 yd. @ $33\frac{1}{3}$ ¢ |
| 96 yd. @ $8\frac{1}{3}$ ¢ | 29 yd. @ 25 ¢ |

POSTAL PROBLEMS

DOMESTIC RATES OF POSTAGE

The following are the rates to all parts of the United States, including Panama Canal Zone, Porto Rico, Guam, Hawaiian Islands, Philippines, Tutuila (Samoan Islands), Canada, Cuba, Mexico, Republic of Panama, and Shanghai, China.

First-class Matter: Letters and all sealed matter, 2 cents an ounce or fraction thereof.

Second-class Matter: Newspapers and periodicals sent by publishers, 1 cent a pound or fraction thereof; when sent by others, 1 cent for four ounces or fraction thereof.

Third-class Matter: Books, circulars, pictures, etc., 1 cent for two ounces or fraction thereof.

Fourth-class Matter: Merchandise and all matter not included in any of the other classes, 1 cent an ounce or fraction thereof, except seeds, which may be sent at the rate of 1 cent for two ounces or fraction thereof.

Registration Fee (to insure safe delivery): 10 cents in addition to regular postage.

Special Delivery Fee (to insure quick delivery): 10 cents in addition to regular postage.

1. What is the postage on a letter weighing $\frac{1}{2}$ oz.? $\frac{3}{4}$ oz.? $1\frac{1}{4}$ oz.? $2\frac{1}{4}$ oz.? 3 oz.? $3\frac{1}{2}$ oz.? 4 oz.? $4\frac{1}{4}$ oz.?

2. Mr. Chase sends by registered mail a letter weighing $2\frac{1}{2}$ ounces. What is the postage?

3. Mr. Luther sends a half-ounce letter by special delivery to his son. What is the postage?

4. A merchant sends in one day 37 letters (5 by special delivery) weighing $\frac{1}{2}$ ounce each, 350 catalogues each weighing $2\frac{3}{4}$ ounces, and 36 packages of samples each weighing $1\frac{1}{2}$ ounces. Find the amount of postage required.

5. A manufacturer sends out 1500 circulars weighing $1\frac{1}{2}$ ounces each, and under separate covers the same number of samples weighing $2\frac{1}{2}$ ounces each. What postage did he pay?

6. A magazine publisher sends by mail one and three quarters tons of magazines each month. What is his yearly bill for postage?

7. Myrtle sent 12 Christmas cards (sealed), 15 postal cards, 2 packages each weighing 5 ounces, 1 package weighing $\frac{3}{4}$ of a pound, and a book weighing 15 ounces. How much did she pay for postage?

8. What postage is paid by a newspaper company on 8 copies of its daily paper if each paper weighs 4 ounces? What postage must Thomas pay if he mails 8 copies of the same paper to his friends?

9. If a copy of a monthly magazine weighs $12\frac{1}{2}$ ounces, what postage must the publisher pay on 800,000 copies?

CASH ACCOUNTS

In cash accounts, "Cash" may be regarded as a person who accounts for one's money. Cash is debtor to money received, and credited with money paid out.

DR.		CASH		CR.			
1911				1911			
Mar. 1	On hand	3	00	Mar. 3	By Shoes	3	50
8	To Allowance	15	00	10	By Books	12	50
9	To Posters	4	50	14	By Sweater	4	75
25	To Present	5	00	16	By Subscription	2	00
				21	By Class Dues	3	00
				31	By Balance	1	75
		27	50			27	50
Apr. 1	On hand	1	75				

Write these accounts in proper form :

1. Cash account of Clara Dow : Receipts: Mar. 1, 1911, on hand \$0.65; Mar. 4, monthly allowance \$4.00;

Mar. 11, old gold \$3.50; Mar. 21, birthday present \$5.00. Expenses: Mar. 2, flowers \$0.50; Mar. 7, book \$1.50; Mar. 10, fruit \$0.85; Mar. 17, charity \$0.60; Mar. 21, concert \$0.75; Mar. 23, bag \$3.00; Mar. 28, pin \$4.25.

2. Cash account of Rufus Brown: Receipts: Mar. 1, 1911, on hand \$65.00; Mar. 8, month's pay at \$30.00 a week; Mar. 10, rent from house \$20.00. Expenses: Mar. 4, taxes \$75.00; Mar. 9, house expenses \$45.00; Mar. 17, clothing \$50.00; Mar. 23, repairs \$5.00.

3. Cash account of a music teacher: Receipts: Mar. 1, 1911, on hand \$8.50; Mar. 2, from 5 pupils, 10 lessons each, at \$2.00 a lesson; Mar. 10, from 3 pupils, 20 lessons each, at \$2.00 a lesson; Mar. 18, from 4 pupils, 10 lessons each, at \$1.50 a lesson. Expenses: Mar. 4, living expenses \$25.00; Mar. 10, tuning pianos \$5.00; Mar. 15, special instruction, 10 lessons at \$5.00 each.

4. Cash account of Mrs. Green: Receipts: Mar. 1, 1911, on hand \$10.00; Mar. 4, rent from rooms \$32.00; Mar. 15, pension \$12.00; Mar. 18, sewing \$9.00; Mar. 25, board \$16.00. Expenses: Mar. 6, groceries \$15.00; Mar. 7, provisions \$18.00; Mar. 11, milk \$2.80; Mar. 15, gas \$4.50; Mar. 21, clothing \$12.50.

5. Cash account of a dressmaker: Receipts: Mar. 1, 1911, on hand \$10.50; Mar. 7, making 2 gowns at \$15.00 each; Mar. 9, trimmings \$5.80; Mar. 16, making waist \$6.00; Mar. 21, cloth and making gown \$28.00; Mar. 28, making 2 gowns at \$18.50 each. Expenses: Mar. 4, seamstress 24 days at \$1.50 a day; Mar. 17, silk and trimmings \$10.00; Mar. 24, buttons and braid \$4.50; Mar. 30, rent \$30.00; Mar. 31, linings \$3.25.

EXPENDITURES OF A PARK COMMISSION

TABLE SHOWING THE AMOUNTS EXPENDED BY A PARK COMMISSION FOR MAINTENANCE AND IMPROVEMENT IN ONE YEAR

	NAME	MAINTENANCE		IMPROVEMENT	
		Labor	Material	Labor	Material
1.	North Common	\$ 672.54	\$ 50.57	\$ 4.31	\$ 31.80
2.	South Common	911.02	46.87		106.92
3.	Fort Hill Park	2272.30	402.11	8575.77	1667.51
4.	Belvidere Park	115.66	35.63		
5.	Tyler Park	133.79	22.84		
6.	Mt. Vernon Park	45.21	10.68		
7.	Monument Square	34.23	37.27	16.70	21.12
8.	City Hall and Memorial Building	125.34	28.78		
9.	Lincoln Playground	16.27		112.97	27.00
10.	Hovey Square	4.63	4.87		
11.	Mansur Square	5.94	12.92		
12.	Colburn Square			2.35	
13.	Lenox Square	16.53		57.11	54.56
14.	Princeton Square	10.28		7.70	18.63
15.	Middlesex Square	6.02		17.24	32.46
16.	Fayette Street Playground	6.56			
17.	Varnum Avenue River Bank	13.35	5.00		
18.	Colonial Avenue River Bank	29.02	8.69		
19.	Glacial Rock				39.60
20.	Water Works Square	6.52	.52	29.21	38.99
21.	Penniman Square	8.02	12.94		
22.	Varnum Square	10.59	22.33	10.69	5.90
23.	Lincoln Square	1.15		89.79	266.00
24.	Stable	106.94	1611.90	19.30	2.20
25.	Carpenter shop	163.01	73.74		
26.	Office Expenses	1344.66	345.93		

1. Find the total amount expended for labor in maintenance.

2. Find the total amount expended for material in maintenance.

3. Find the total amount expended for maintenance.
4. What was the total amount expended for labor in improvement?
5. What was the total amount expended for material in improvement?
6. What was the total amount expended for improvement?
7. What is the sum of answers to 3 and 6? What does it represent?
8. What was the total amount expended on North Common? On each of the other parks? For other purposes?
9. Find the sum of the amounts expended.
10. Compare the answer to 9 and the answer to 7.

REVIEW EXERCISE

1. Which of these numbers are concrete? Abstract?
7 men 3 \$5 17 19 days 150
2. What is an abstract number? A concrete number?
3. Which of these numbers are prime? Composite?
42 37 56 63 19 39 61 84 47
4. What is a prime number? A composite number?
5. What are the factors of 24? 56? 84? 120?
6. What is meant by the factors of a number?
7. What are the prime factors of 56? 96? 144?
8. What is a prime factor?
9. What number is represented by $2^3 \times 5$? By $4^2 \times 3^2$? By $5^3 \times 2^2$?
10. What does the exponent of a number tell?

11. What is the greatest common divisor of 12, 15, and 18? Of 24, 36, 60? Of 28, 35, 56?

12. What is the length of the longest stick that will exactly measure distances of either 15 feet, 18 feet, or 30 feet?

13. What is the least common multiple of 9, 12, 18? Of 12, 15, 20? Of 8, 16, 24?

14. Two men start from the same point and walk around a circular pond. The first makes the circuit in 12 minutes and the second in 15 minutes. How many minutes before they will come together at the starting point?

15. What is the least length of dress goods that can be woven in one piece so that it can be cut without waste into dress patterns of either 6 yards, 10 yards, or 12 yards?

FRACTIONS

Oral

1. What is a unit? A fraction?

2. In the fraction $\frac{3}{4}$, what does each term show?

In a fraction what name is given:

3. To the number below the line? What does it show?

4. To the number above the line? What does it show?

5. Name the fraction which shows what part of the month of September is 1 week; 3 weeks; 1 week 5 days; $2\frac{1}{2}$ weeks.

6. What name is given to a fraction whose value is less than 1? Whose value is 1? Whose value is more than 1?

7. What name is given to a number consisting of a whole number and a fraction?

8. Change to improper fractions:

$$3 \frac{1}{8} \quad 3 \frac{7}{9} \quad 2 \frac{9}{10} \quad 8 \frac{1}{5} \quad 6 \frac{3}{7} \quad 5 \frac{1}{8} \quad 7 \frac{7}{12} \quad 9 \frac{1}{4} \quad 8 \frac{2}{11}$$

9. Change to mixed numbers:

$$\frac{18}{5} \quad \frac{27}{9} \quad \frac{48}{5} \quad \frac{50}{7} \quad \frac{67}{12} \quad \frac{27}{4} \quad \frac{25}{6} \quad \frac{62}{15} \quad \frac{72}{20} \quad \frac{84}{15}$$

The form of a fraction may be changed without changing its value. This may be done in two ways:

(1) By changing to higher terms. Thus, $\frac{2}{4} = \frac{1}{2}$.

10. Change to higher terms: $\frac{5}{12}$ $\frac{7}{8}$ $\frac{3}{10}$ $\frac{5}{9}$

11. How is a fraction changed to higher terms?

(2) By changing to lower terms. Thus, $\frac{6}{8} = \frac{3}{4}$.

12. Change to lower terms: $\frac{9}{18}$ $\frac{18}{27}$ $\frac{15}{24}$ $\frac{12}{20}$

13. How is a fraction changed to lower terms?

14. Change to lowest terms: $\frac{14}{16}$ $\frac{10}{15}$ $\frac{12}{14}$ $\frac{24}{30}$ $\frac{30}{36}$

15. When is a fraction in its lowest terms?

16. Multiplying or dividing both terms of a fraction by the same number does not change the value of the fraction. What is changed?

WRITTEN EXERCISE

1. Write as fractions with 5 for a denominator:

$$1 \quad 5 \quad 8 \quad 7 \quad 12 \quad 15$$

2. Write five fractions each equal to 1; five equal to $\frac{1}{10}$; five equal to $\frac{3}{4}$.

3. Write $\frac{7}{8}$ in as many forms as possible having two figures in the denominator.

4. Change to 36ths:

$$1 \quad 3 \quad \frac{1}{2} \quad \frac{2}{3} \quad \frac{3}{4} \quad \frac{5}{6} \quad \frac{7}{8} \quad \frac{5}{12} \quad \frac{11}{18} \quad \frac{22}{27} \quad \frac{24}{108} \quad \frac{52}{144}$$

Change to lowest terms:

- | | | | | |
|-----------------------|-----------------------|-----------------------|-----------------------|-------------------------|
| 5. $\frac{7}{7}$ | 6. $\frac{45}{9}$ | 7. $\frac{27}{88}$ | 8. $\frac{22}{24}$ | 9. $\frac{42}{66}$ |
| 10. $\frac{28}{84}$ | 11. $\frac{55}{105}$ | 12. $\frac{72}{108}$ | 13. $\frac{168}{680}$ | 14. $\frac{288}{482}$ |
| 15. $\frac{80}{144}$ | 16. $\frac{54}{128}$ | 17. $\frac{120}{576}$ | 18. $\frac{275}{600}$ | 19. $\frac{288}{312}$ |
| 20. $\frac{70}{98}$ | 21. $\frac{144}{252}$ | 22. $\frac{85}{120}$ | 23. $\frac{272}{480}$ | 24. $\frac{144}{216}$ |
| 25. $\frac{84}{105}$ | 26. $\frac{64}{298}$ | 27. $\frac{84}{144}$ | 28. $\frac{231}{375}$ | 29. $\frac{425}{800}$ |
| 30. $\frac{168}{256}$ | 31. $\frac{175}{325}$ | 32. $\frac{185}{252}$ | 33. $\frac{156}{288}$ | 34. $\frac{2000}{2240}$ |

Change to improper fractions:

- | | | | | |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 35. $12\frac{7}{16}$ | 36. $14\frac{2}{17}$ | 37. $18\frac{2}{11}$ | 38. $19\frac{5}{15}$ | 39. $19\frac{7}{24}$ |
| 40. $18\frac{5}{9}$ | 41. $23\frac{5}{16}$ | 42. $25\frac{11}{16}$ | 43. $37\frac{2}{20}$ | 44. $42\frac{7}{25}$ |
| 45. $39\frac{12}{19}$ | 46. $58\frac{17}{26}$ | 47. $48\frac{12}{28}$ | 48. $53\frac{7}{32}$ | 49. $67\frac{12}{37}$ |
| 50. $73\frac{17}{40}$ | 51. $85\frac{12}{50}$ | 52. $79\frac{17}{48}$ | 53. $87\frac{22}{60}$ | 54. $95\frac{22}{72}$ |

Change to mixed numbers:

- | | | | | |
|----------------------|----------------------|----------------------|----------------------|----------------------|
| 55. $\frac{112}{17}$ | 56. $\frac{182}{85}$ | 57. $\frac{214}{29}$ | 58. $\frac{200}{48}$ | 59. $\frac{422}{67}$ |
| 60. $\frac{192}{18}$ | 61. $\frac{207}{24}$ | 62. $\frac{247}{38}$ | 63. $\frac{252}{37}$ | 64. $\frac{521}{45}$ |
| 65. $\frac{472}{50}$ | 66. $\frac{285}{62}$ | 67. $\frac{477}{58}$ | 68. $\frac{542}{74}$ | 69. $\frac{277}{60}$ |
| 70. $\frac{782}{85}$ | 71. $\frac{542}{88}$ | 72. $\frac{712}{79}$ | 73. $\frac{207}{92}$ | 74. $\frac{287}{96}$ |

ADDITION AND SUBTRACTION

1. $\frac{2}{4} + \frac{2}{6} = ?$

$\frac{15}{20} + \frac{12}{20} = ?$

2. $\frac{2}{4} - \frac{2}{6} = ?$

$\frac{15}{20} - \frac{12}{20} = ?$

3. What change must be made in $\frac{2}{4}$ and $\frac{2}{6}$ before finding their sum or difference?

4. What kind of fractions can be added and subtracted?

Add at sight:

- | | | | | |
|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| 5. $5\frac{1}{2}$ | 6. $5\frac{1}{4}$ | 7. $6\frac{3}{4}$ | 8. $2\frac{1}{2}$ | ✓ 9. $2\frac{1}{4}$ |
| $2\frac{1}{2}$ | $3\frac{1}{2}$ | $3\frac{3}{4}$ | $4\frac{1}{4}$ | $3\frac{3}{8}$ |
| $7\frac{1}{2}$ | $2\frac{3}{4}$ | $8\frac{3}{4}$ | $3\frac{1}{4}$ | $2\frac{5}{8}$ |
| <u>$3\frac{1}{2}$</u> | <u>$4\frac{1}{2}$</u> | <u>$7\frac{1}{4}$</u> | <u>$8\frac{3}{4}$</u> | <u>$9\frac{1}{4}$</u> |
| 10. $7\frac{1}{2}$ | 11. $3\frac{5}{8}$ | 12. $9\frac{7}{8}$ | 13. $4\frac{5}{8}$ | ✓ 14. $7\frac{1}{8}$ |
| $3\frac{1}{4}$ | $9\frac{1}{8}$ | $8\frac{5}{8}$ | $3\frac{1}{2}$ | $2\frac{1}{2}$ |
| $2\frac{1}{8}$ | $1\frac{1}{4}$ | $3\frac{1}{2}$ | $2\frac{1}{2}$ | $3\frac{1}{8}$ |
| <u>$8\frac{1}{2}$</u> | <u>$5\frac{1}{2}$</u> | <u>$2\frac{3}{4}$</u> | <u>$9\frac{5}{8}$</u> | <u>$4\frac{3}{8}$</u> |
| 15. $8\frac{1}{2}$ | 16. $5\frac{1}{4}$ | 17. $6\frac{1}{5}$ | 18. $8\frac{4}{5}$ | ✓ 19. $6\frac{1}{4}$ |
| $3\frac{5}{8}$ | $2\frac{1}{8}$ | $7\frac{1}{8}$ | $3\frac{1}{8}$ | $5\frac{1}{8}$ |
| $7\frac{1}{6}$ | $7\frac{5}{12}$ | $9\frac{1}{10}$ | $9\frac{1}{5}$ | $9\frac{1}{10}$ |
| <u>$9\frac{1}{3}$</u> | <u>$9\frac{2}{3}$</u> | <u>$8\frac{4}{5}$</u> | <u>$5\frac{2}{5}$</u> | <u>$8\frac{1}{2}$</u> |

Subtract at sight:

- | | | | | |
|----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|----------------------------------|
| 20. $8\frac{1}{2}$ | 21. $7\frac{1}{2}$ | 22. $4\frac{3}{4}$ | 23. $5\frac{3}{8}$ | ✓ 24. $9\frac{5}{8}$ |
| $2\frac{1}{4}$ | $3\frac{1}{8}$ | $1\frac{1}{2}$ | $2\frac{1}{2}$ | $4\frac{1}{2}$ |
| <u>$2\frac{1}{4}$</u> | <u>$3\frac{1}{8}$</u> | <u>$1\frac{1}{2}$</u> | <u>$2\frac{1}{2}$</u> | <u>$4\frac{1}{2}$</u> |
| 25. $7\frac{1}{2}$ | 26. $9\frac{1}{10}$ | 27. $6\frac{1}{2}$ | 28. $8\frac{1}{2}$ | ✓ 29. $5\frac{1}{2}$ |
| $3\frac{1}{8}$ | $6\frac{1}{5}$ | $4\frac{2}{5}$ | $3\frac{1}{10}$ | $2\frac{1}{6}$ |
| <u>$3\frac{1}{8}$</u> | <u>$6\frac{1}{5}$</u> | <u>$4\frac{2}{5}$</u> | <u>$3\frac{1}{10}$</u> | <u>$2\frac{1}{6}$</u> |
| 30. $4\frac{5}{8}$ | 31. $6\frac{2}{3}$ | 32. $5\frac{1}{2}$ | 33. $9\frac{1}{3}$ | ✓ 34. $7\frac{2}{9}$ |
| $1\frac{1}{4}$ | $4\frac{1}{4}$ | $3\frac{5}{16}$ | $3\frac{1}{9}$ | $2\frac{2}{3}$ |
| <u>$1\frac{1}{4}$</u> | <u>$4\frac{1}{4}$</u> | <u>$3\frac{5}{16}$</u> | <u>$3\frac{1}{9}$</u> | <u>$2\frac{2}{3}$</u> |

Solve at sight:

- | | | | |
|------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| 35. $\frac{3}{8} + \frac{5}{6}$ | 36. $\frac{4}{5} - \frac{3}{4}$ | 37. $\frac{6}{7} + 2\frac{1}{4}$ | 38. $\frac{7}{8} - \frac{3}{10}$ |
| 39. $\frac{5}{6} + 2\frac{7}{4}$ | 40. $\frac{7}{10} - \frac{5}{12}$ | 41. $\frac{7}{10} + \frac{4}{15}$ | 42. $\frac{5}{6} - \frac{4}{15}$ |
| 43. $\frac{5}{11} + \frac{3}{4}$ | 44. $\frac{8}{9} - \frac{5}{6}$ | 45. $\frac{3}{8} + \frac{7}{12}$ | 46. $\frac{7}{9} - \frac{7}{27}$ |
| 47. $\frac{7}{12} + \frac{11}{36}$ | 48. $\frac{8}{15} - \frac{3}{20}$ | 49. $\frac{5}{9} + \frac{8}{15}$ | 50. $\frac{11}{15} - \frac{2}{5}$ |
| 51. $\frac{9}{10} + \frac{1}{25}$ | 52. $\frac{11}{12} - \frac{5}{9}$ | 53. $\frac{7}{16} + \frac{1}{3}$ | 54. $\frac{3}{4} - \frac{2}{15}$ |

WRITTEN EXERCISES

1. Add $1\frac{3}{5}$ and $1\frac{1}{4}$.

$$\begin{array}{r} 3)15 \quad 24 \\ \hline 5 \quad 8 \end{array}$$

$$3 \times 5 \times 8 = 120$$

$$\text{l. c. d.} = 120$$

$$1\frac{3}{5} = \frac{120}{5} = 24$$

$$1\frac{1}{4} = \frac{120}{4} = 30$$

$$24 + 30 = 54$$

$$\frac{54}{120} = 1\frac{9}{20} = 1\frac{9}{20}$$

Since the least common denominator is not readily seen, we find the least common multiple of the denominators.

2. $\frac{5}{8} + \frac{7}{12} + \frac{9}{16}$

3. $\frac{2}{15} + \frac{3}{10} + \frac{5}{6}$

4. $\frac{8}{9} + \frac{2}{7} + \frac{3}{8}$

5. $\frac{3}{14} + \frac{11}{42} + \frac{5}{14}$

6. $\frac{5}{6} + \frac{4}{21} + \frac{9}{14}$

7. $\frac{7}{9} + \frac{5}{18} + \frac{7}{12}$

8. $\frac{9}{10} + \frac{1}{15} + \frac{1}{20}$

9. $\frac{7}{12} + \frac{7}{15} + \frac{7}{10}$

10. $\frac{11}{12} + \frac{8}{9} + \frac{1}{18}$

11. $\frac{11}{60} + \frac{7}{12} + \frac{9}{20}$

12. $\frac{3}{14} + \frac{7}{8} + \frac{5}{7}$

13. $\frac{17}{18} + \frac{5}{12} + \frac{17}{24}$

14. $\frac{7}{16} + \frac{1}{8} + \frac{7}{12} + \frac{1}{24}$

15. $\frac{4}{5} + \frac{3}{4} + \frac{7}{20} + \frac{8}{15}$

16. $\frac{3}{7} + \frac{5}{8} + \frac{1}{2} + \frac{3}{4}$

17. $\frac{8}{25} + \frac{2}{3} + \frac{4}{15} + \frac{3}{5}$

18. $\frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6}$

19. $\frac{2}{5} + \frac{7}{10} + \frac{1}{15} + \frac{1}{20} + \frac{5}{12}$

20. $\frac{1}{7} + \frac{1}{8} + \frac{3}{4} + \frac{1}{2} + \frac{5}{14}$

21. $\frac{5}{6} + \frac{2}{7} + \frac{1}{14} + \frac{2}{3} + \frac{5}{21}$

22. Take $12\frac{1}{8}$ from $16\frac{1}{8}$.

$$\text{l. c. d.} = 90$$

$$16\frac{1}{8} = 16\frac{11}{88} = 15\frac{141}{88}$$

$$12\frac{1}{8} = 12\frac{11}{88} = 12\frac{11}{88}$$

$$\frac{141}{88} - \frac{11}{88} = 3\frac{130}{88} = 3\frac{13}{8}$$

Since we cannot take $\frac{11}{88}$ from $\frac{11}{88}$, we take 1 from 16, express it as $\frac{88}{88}$, and add it to $\frac{11}{88}$, making $\frac{141}{88}$.

Find the value of:

23. $7\frac{3}{8} + 4\frac{7}{12}$

24. $8\frac{5}{8} - 3\frac{7}{8}$

25. $9\frac{2}{3} + 7\frac{5}{8}$

26. $6\frac{3}{4} - 2\frac{5}{8}$

27. $8\frac{3}{4} + 8\frac{1}{4}$

28. $9\frac{1}{12} - 4\frac{3}{4}$

29. $4\frac{1}{6} + 8\frac{5}{6}$

30. $7\frac{3}{10} - 5\frac{2}{5}$

31. $5\frac{1}{6} + 5\frac{1}{6}$

32. $8\frac{3}{7} - 2\frac{5}{8}$

33. $7\frac{8}{9} + 5\frac{5}{9}$

34. $4\frac{5}{9} - 1\frac{7}{12}$

35. $12\frac{4}{9} + 7\frac{8}{16}$

36. $10\frac{4}{15} - 5\frac{7}{20}$

37. $16\frac{9}{25} + 8\frac{7}{10}$

38. $19\frac{5}{12} - 8\frac{1}{6}$ 39. $18\frac{1}{6} + 12\frac{5}{8}$ 40. $20\frac{1}{6} - 12\frac{1}{3}$
 41. $25\frac{1}{4} + 16\frac{1}{8}$ 42. $15\frac{1}{12} - 11\frac{7}{16}$ 43. $28\frac{7}{10} + 15\frac{1}{8}$
 44. $25\frac{10}{27} - 18\frac{2}{15}$ 45. $36\frac{4}{85} + 42\frac{7}{10}$ 46. $50\frac{2}{24} - 24\frac{7}{30}$

MULTIPLICATION OF FRACTIONS

Give products at sight:

1. $5 \times \frac{2}{3}$ 2. $8 \times \frac{1}{8}$ 3. $9 \times \frac{1}{6}$ 4. $7 \times \frac{3}{10}$
 5. $8 \times 1\frac{1}{2}$ 6. $7 \times 4\frac{1}{2}$ 7. $8 \times 2\frac{1}{2}$ 8. $10 \times 3\frac{1}{2}$
 9. $\frac{2}{3} \times 72$ 10. $\frac{4}{5} \times 10$ 11. $\frac{7}{9} \times 54$ 12. $\frac{2}{3} \times 11$
 13. $3\frac{1}{2} \times 80$ 14. $\frac{7}{12} \times 9$ 15. $\frac{4}{5} \times 84$ 16. $\frac{2}{3} \times 16$
 17. $\frac{2}{3} \times \frac{3}{5}$ 18. $\frac{2}{3} \times 2\frac{1}{7}$ 19. $\frac{1}{8} \times \frac{1}{6}$ 20. $\frac{2}{3} \times \frac{1}{4}$
 21. $\frac{4}{7} \times 1\frac{1}{5}$ 22. $\frac{2}{10} \times \frac{2}{13}$ 23. $\frac{2}{11} \times \frac{5}{18}$ 24. $\frac{1}{6} \times 1\frac{1}{3}$

Solve:

25. $15 \times 2\frac{1}{7}$ 26. $21 \times \frac{5}{8}$ 27. $8 \times 3\frac{1}{4}$ 28. $9 \times 1\frac{1}{6}$
 29. $37 \times 5\frac{2}{10}$ 30. $36 \times 3\frac{1}{2}$ 31. $25 \times 5\frac{1}{2}$ 32. $6 \times 12\frac{1}{2}$
 33. $\frac{1}{6} \times 80$ 34. $\frac{2}{5} \times 95$ 35. $\frac{1}{3} \times 5$ 36. $\frac{7}{8} \times 15$
 37. $3\frac{1}{2} \times 52$ 38. $4\frac{1}{16} \times 8$ 39. $5\frac{3}{10} \times 25$ 40. $15\frac{1}{8} \times 25$
 41. $\frac{1}{24} \times \frac{3}{51}$ 42. $\frac{2}{11} \times 1\frac{1}{11}$ 43. $\frac{2}{5} \times \frac{6}{16}$ 44. $\frac{2}{16} \times \frac{8}{8}$
 45. $\frac{1}{287} \times \frac{7}{8}$ 46. $\frac{1}{16} \times 1\frac{1}{7}$ 47. $\frac{25}{144} \times 1\frac{1}{25}$ 48. $\frac{28}{165} \times 8\frac{1}{4}$

DIVISION

1. Divide $\frac{4}{7}$ by $\frac{2}{3}$.

Change to like fractions, and divide the numerator of the dividend by the numerator of the divisor.

$$\frac{4}{7} \div \frac{2}{3} = \frac{12}{7} \div \frac{14}{7} = 12 \div 14 = \frac{6}{7}$$

Or, for convenience, invert the divisor and multiply, canceling when possible.

$$\frac{4}{7} \div \frac{2}{3} = \frac{4}{7} \times \frac{3}{2} = \frac{6}{7}$$

$$\begin{array}{r} 16 \\ 12 \\ \hline 192 \end{array}$$

$$\begin{array}{r} 16 \\ 4 \\ \hline 64 \end{array}$$

COMPLEX FRACTIONS

$$\begin{array}{r} 84 \\ 69 \\ \hline 15 \\ \hline 23 \end{array}$$

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Solve at sight:

2. $3 + \frac{1}{4}$

3. $6 + \frac{1}{9} \frac{16}{6}$

4. $8 + \frac{1}{7} \frac{81}{64}$

5. $12 + \frac{1}{8}$

6. $5 + \frac{1}{5}$

7. $7 + \frac{1}{15}$

8. $9 + \frac{1}{11}$

9. $15 + \frac{1}{8}$

10. $\frac{2}{3} + 4$

11. $\frac{2}{4} + 6$

12. $\frac{5}{8} + 10$

13. $\frac{4}{9} + 12$

14. $\frac{3}{8} + 6$

15. $\frac{10}{10} + 3$

16. $\frac{4}{8} + 6$

17. $\frac{1}{8} + 5$

18. $\frac{8}{8} + \frac{1}{8}$

19. $\frac{8}{8} + \frac{1}{8}$

20. $\frac{8}{8} + \frac{1}{8}$

21. $\frac{2}{4} + \frac{1}{8} \frac{13}{5}$

22. $\frac{1}{7} + \frac{1}{7}$

23. $\frac{8}{8} + \frac{1}{12}$

24. $\frac{2}{10} + \frac{1}{4}$

25. $\frac{4}{8} + \frac{1}{8} \frac{65}{5}$

Solve:

Written

25. $8 + 3\frac{1}{8}$

27. $12 + 5\frac{1}{4}$

28. $17 + 4\frac{1}{2}$

29. $20 + 8\frac{1}{2}$

30. $224 + 6\frac{1}{2}$

31. $25 + 4\frac{1}{2}$

32. $36 + 3\frac{1}{2}$

33. $42 + 5\frac{1}{2}$

34. $350 + 8\frac{1}{2}$

35. $72 + 7\frac{1}{2}$

36. $84 + 9\frac{1}{2}$

37. $96 + 8\frac{1}{2} \frac{16}{86}$

38. $12\frac{2}{18} + 3$

39. $15\frac{1}{2} + 2$

40. $8\frac{2}{10} + 4$

41. $16\frac{1}{2} + 7 \frac{128}{6}$

42. $20\frac{1}{4} + 8$

43. $32\frac{1}{5} + 9$

44. $24\frac{1}{2} + 5$

45. $12\frac{2}{10} + 3$

46. $44\frac{1}{5} + 9$

47. $67\frac{1}{2} + 7$

48. $42\frac{1}{2} + 8$

49. $65\frac{1}{8} + 4$

50. $80\frac{1}{18} + 6$

51. $56\frac{2}{11} + 5$

52. $29\frac{5}{12} + 7$

53. $29\frac{1}{2} + 8$

54. $30\frac{2}{10} + 9$

55. $90\frac{1}{8} + 7$

56. $60\frac{1}{2} + 5$

57. $66\frac{1}{2} + 6 \frac{51}{6}$

58. $67\frac{1}{2} + 8$

59. $62\frac{1}{2} + 9$

60. $83\frac{1}{2} + 7$

61. $125\frac{1}{8} + 12 \frac{460}{8}$

62. $4\frac{1}{2} + 6\frac{1}{2}$

63. $3\frac{1}{2} + 3\frac{1}{2}$

64. $9\frac{1}{2} + 3\frac{1}{2}$

65. $4\frac{1}{11} + 6\frac{1}{2} \frac{81}{4}$

66. $12\frac{1}{2} + 15\frac{1}{2}$

67. $16\frac{1}{2} + 18\frac{1}{2}$

68. $37\frac{1}{2} + 13\frac{1}{2}$

69. $33\frac{1}{2} + 14\frac{1}{2} \frac{324}{4}$

70. $5\frac{1}{2} + 6\frac{1}{2}$

71. $4\frac{1}{2} + 6\frac{1}{2}$

72. $5\frac{1}{2} + 8\frac{1}{2}$

73. $7\frac{2}{18} + 2\frac{5}{12}$

74. $18\frac{1}{2} + 12\frac{1}{2}$

75. $14\frac{1}{2} + 10\frac{1}{2}$

76. $42\frac{1}{2} + 22\frac{1}{2}$

77. $62\frac{1}{2} + 83\frac{1}{2}$

COMPLEX FRACTIONS

Such expressions as $\frac{2}{3\frac{1}{2}}$, $\frac{4\frac{1}{2}}{3}$, $\frac{3\frac{1}{2}}{2\frac{1}{3}}$, are *complex fractions*.

They are simplified by performing the operation indicated.

$$\frac{416}{12}$$

$$\frac{1235}{1152}$$

$$\frac{16}{13}$$

$$\frac{1265}{1245}$$

ADVANCED ARITHMETIC

1 Find the value of $\frac{3\frac{3}{4}}{1\frac{2}{3}}$.

$$(1) \frac{3\frac{3}{4}}{1\frac{2}{3}} = 3\frac{3}{4} \div 1\frac{2}{3} = \frac{15}{4} \times \frac{3}{5} = \frac{9}{4} = 2\frac{1}{4}$$

Since multiplying both terms of a fraction by the same number does not change the value of the fraction, we may simplify by multiplying both terms by the least common multiple of the denominators.

$$(2) \frac{3\frac{3}{4} \times 12}{1\frac{2}{3} \times 12} = \frac{45}{20} = \frac{9}{4} = 2\frac{1}{4}$$

Solve:

2. $\frac{3\frac{1}{2}}{1\frac{2}{3}}$

3. $\frac{2\frac{1}{2}}{1\frac{1}{2}}$

4. $\frac{1\frac{3}{5}}{5\frac{3}{8}}$

5. $\frac{5\frac{1}{2}}{2\frac{1}{4}}$

6. $\frac{15\frac{5}{6}}{12\frac{2}{3}}$

7. $\frac{7\frac{1}{2}}{6\frac{2}{3}}$

8. $\frac{2\frac{2}{5}}{3\frac{2}{4}}$

9. $\frac{2\frac{1}{4}}{3\frac{1}{8}}$

10. $\frac{2\frac{5}{8}}{2\frac{3}{4}}$

11. $\frac{8\frac{1}{2}}{3\frac{5}{6}}$

12. $\frac{20\frac{1}{4}}{15\frac{3}{4}}$

13. $\frac{6\frac{2}{5}}{7\frac{5}{6}}$

14. $\frac{14\frac{2}{5}}{4\frac{3}{8}}$

15. $\frac{18\frac{3}{4}}{16\frac{2}{3}}$

16. $\frac{5\frac{7}{8}}{13\frac{1}{3}}$

Solve, first simplifying the parts in parentheses:

17. $(\frac{3}{8} + \frac{1}{5}) \div (\frac{1}{8} + \frac{1}{6})$

19. $(\frac{1}{2} + \frac{2}{3}) \div (\frac{4}{5} - \frac{1}{2})$

21. $(\frac{3}{4} \div 3\frac{1}{5}) \times (\frac{4}{5} - \frac{2}{3})$

23. $(2\frac{3}{8} + 1\frac{1}{5}) - (6\frac{1}{4} - 5\frac{1}{8})$

25. $(4\frac{2}{3} \times 4\frac{1}{5}) - (8\frac{3}{4} - 4\frac{3}{10})$

MISCELLANEOUS PROBLEMS

1. Mr. Bryant sold three piles of wood containing $8\frac{1}{2}$ cords, $4\frac{2}{16}$ cords, and $7\frac{5}{8}$ cords, respectively. How many cords in all?

MISCELLANEOUS PROBLEMS

2. Eight drinking fountains were placed in a school building at an average expense of \$6 $\frac{1}{2}$. How much did they cost?

3. A post 8 $\frac{1}{2}$ feet long is set 2 $\frac{3}{4}$ feet in the ground. What is the length above ground?

4. A special electric car was hired by a party for \$22 $\frac{1}{4}$. If each person paid \$2 $\frac{7}{10}$, how many went on the trip?

5. Mrs. Appleton bought a piece of beef weighing 7 $\frac{3}{4}$ pounds. One third of the weight was lost in roasting. What was the weight of the roast when ready for the table?

6. Wallace bought a sled for \$ $\frac{4}{5}$, and a knife for $\frac{9}{16}$ as much. How much did he pay for both?

7. At \$8 $\frac{4}{5}$ a cord, what is the value of a pile of wood containing 1 $\frac{1}{2}$ cords?

8. From a board 13 $\frac{1}{2}$ feet long there were cut 2 pieces, each 6 $\frac{3}{4}$ feet long. What was the waste?

9. How much must a carpenter be paid for 38 hours' work if he receives \$3.50 per day of 8 hours?

10. If a merchant pays \$2 $\frac{7}{5}$ apiece for melons and sells them at \$ $\frac{3}{2}$ apiece, what is his gain?

11. A ton of lime for fertilizing cost \$6 $\frac{1}{4}$. It cost $\frac{3}{4}$ as much to cart it from the freight depot to the farm. What was the total cost?

12. A merchant sold a piece of cloth containing 3 $\frac{1}{2}$ yards for \$10 $\frac{3}{4}$. At the same rate per yard, he sold another piece for \$17 $\frac{1}{4}$. How many yards in the second piece?

13. A merchant sells 16 $\frac{3}{4}$ dozen pairs of shears at \$ $\frac{3}{4}$ per pair. How much does he receive for them?

- ✓ 14. A cargo of lumber valued at \$6500 was lost at sea. Mr. James owned $\frac{2}{3}$ of it. What was his loss?
- + 15. At the village store, Mrs. Linwood exchanged $8\frac{1}{2}$ dozen eggs at 30 cents a dozen for $3\frac{1}{2}$ yards of cloth. What was the price of the cloth a yard?
- + 16. The price of a railroad ticket between two places is 90 cents. How much will it be if increased $\frac{1}{3}$? How much if increased $\frac{1}{2}$ of a dollar?
- + 17. An electric railway is $16\frac{1}{2}$ miles long. If it followed the highway, its length would be $22\frac{1}{2}$ miles. How many miles are saved by not following the highway?
- + 18. At $\$ \frac{2}{3}$ per gallon, what is the value of 27 barrels of machine oil, each containing 48 gallons?
- + 19. Two fifths of Mr. Johnson's farm is in pasture, $\frac{1}{3}$ in hay and grain, and the rest in other crops. What part in other crops?
- + 20. Three boys own a boat. Robert owns $\frac{2}{3}$ of it, Raymond owns $\frac{1}{3}$ of it. What part of it does George own? If they sell the boat for \$30, how much ought each to receive?
- + 21. At $\$27\frac{1}{2}$ a ton, what is the cost of $62\frac{1}{2}$ tons of steel rails?
- + 22. A farmer paid $\$35\frac{3}{4}$ for plowing $8\frac{1}{2}$ acres of land. How much per acre?
- + 23. The perimeter of a triangular lot of land is $65\frac{1}{2}$ rods. Two of the sides are $18\frac{3}{4}$ rods and $25\frac{1}{4}$ rods, respectively. What is the length of the third side?
- + 24. Robert sells, for 5 cents a copy, a weekly magazine which he buys for $3\frac{1}{2}$ cents a copy. He makes 75 cents a week. How many customers has he?

25. What is the gain when 1260 bushels of wheat are bought at $87\frac{1}{2}$ cents a bushel and sold at $93\frac{1}{4}$ cents a bushel?

26. A farmer paid \$120 for a horse and sold it at a gain of $\frac{1}{8}$ of the cost. What was the gain? What was the selling price?

27. When hats bought at the rate of 5 for \$3 are sold at the rate of 3 for \$5, what is the profit on 5 cases of 4 dozen each?

28. When hay was worth \$16 a ton, Mr. Parker sold $1\frac{1}{4}$ tons to Mr. Hatch, receiving in payment 48 bushels of oats and \$6.40 in money. What was the value of the oats per bushel?

X 29. Oscar lives $2\frac{1}{4}$ miles from Paul. When Oscar has walked $\frac{1}{4}$ of the distance to Paul's home, how far has Paul to walk to meet him?

X 30. Two men harvested a farmer's apples for \$120. If one did $\frac{2}{5}$ of the work, how much ought each to get?

X 31. At another time these same men earned \$120 in cutting timber in the wood lot, one cutting $\frac{2}{5}$ as much as the other. How much did each earn?

X 32. A house was sold at a profit of \$861. The selling price was $\frac{1}{7}$ more than it cost. What was the cost? The selling price?

X 33. A farmer bought a two-horse sulky plow for \$33.75, and by renting it at 75 cents a day received enough money to pay $\frac{2}{3}$ of the cost. How many days did he rent it?

34. A building lot containing 10,800 square feet was bought for $\$ \frac{1}{8}$ per square foot and sold for $\$ \frac{1}{6}$ per square foot. What was the gain?

35. If Mr. Hawley owns $\frac{3}{20}$ of a mine and sells $\frac{1}{5}$ of his share, what part of the mine does he still own?

36. When $\frac{2}{3}$ of a ship is sold for \$3780, what is the ship worth?

37. A barge containing 1625 tons of coal must be unloaded in 5 days. If the bucket used holds $\frac{1}{4}$ of a ton, how many bucketfuls must be taken out each day?

38. A fruit merchant buys apples at \$1 $\frac{1}{2}$ per barrel and sells at \$1 $\frac{1}{4}$ per barrel. If the expense of handling is \$ $\frac{1}{10}$ per barrel, what is his profit in buying and selling 640 barrels?

39. A workman in a shoe manufactory receives 32 cents an hour for a day's work of 8 hours. When he works overtime, each extra hour is reckoned as 1 $\frac{1}{2}$ hours. How much does he earn in a week when he works as follows: Monday 8 hours, Tuesday 10 hours, Wednesday 9 $\frac{1}{2}$ hours, Thursday 9 hours, Friday 10 $\frac{1}{2}$ hours, and Saturday 11 hours?

40. A tub of butter weighed 56 pounds. The grocer sold $\frac{1}{2}$ of it to one customer and $\frac{1}{2}$ the remainder to another customer. How many pounds were left?

41. After using 3 $\frac{1}{2}$ yards of cloth at one time, and $\frac{2}{3}$ as much at another, 7 $\frac{1}{4}$ yards were left. How many yards at first?

42. One mason can lay a wall in 12 days; another mason can lay it in 15 days. If the wages of the first are \$4 per day, what ought to be the daily wages of the second?

43. A gang of men can build a piece of road in 2 $\frac{3}{4}$ weeks, working 10 hours a day. How long will it take if they work 8 hours a day?

44. James and Arthur, working together, can hoe a field of corn in 6 days. How long will it take either alone?

45. The same boys can each hoe another field in 8 days. How long will it take them working together?

46. Three men, working together, can clapboard a house in 4 days. How long will it take one man alone? Two men?

47. One man can cultivate a field of beets in 18 hours. How long will it take 2 men? How long will it take 3 men?

48. Mr. Cross can plant a field to potatoes in 4 days; his son Albert can plant it in 12 days. What part of the work can Mr. Cross do in 1 day? Albert? Mr. Cross and Albert together? How many days will it take both together to plant the field?

49. One man can do a piece of work in 6 days and another man can do the same work in 8 days. How long will it take both together to do the work?

Together in one day they can do $\frac{1}{6} + \frac{1}{8}$, or $\frac{7}{24}$ of the work. The fraction $\frac{7}{24}$ tells that if the work is divided into 24 equal parts, both men together can do 7 of these parts in one day. Therefore, it will take as many days for both together to do the work as 7 is contained times in 24. *Ans.*, $3\frac{3}{7}$ days.

50. A gang of men can build a sewer in 6 weeks. Another gang can build it in 4 weeks. How long will it take both gangs together?

51. An oil reservoir in Pennsylvania has three outlets. The first can empty it in 10 hours, the second in 12 hours, and the third in 15 hours. How long will it take the first and second together? The first and third?

The second and third? Find the shortest time in which the reservoir can be emptied.

- X 52. Emma and Clara can do the week's ironing in 2 hours. Emma alone in 6 hours. In what time can Clara do it alone?

REVIEW EXERCISE

	A		B		C		D	
1.	$\frac{10}{12}$	$\frac{16}{48}$	$\frac{18}{38}$	$\frac{75}{100}$	$\frac{60}{75}$	$\frac{10}{100}$	$\frac{28}{58}$	$\frac{28}{58}$
2.	$\frac{6}{9}$	$\frac{27}{84}$	$\frac{32}{36}$	$\frac{15}{40}$	$\frac{49}{84}$	$\frac{40}{48}$	$\frac{36}{54}$	$\frac{25}{35}$
3.	$\frac{18}{27}$	$\frac{15}{35}$	$\frac{28}{49}$	$\frac{14}{49}$	$\frac{63}{72}$	$\frac{15}{40}$	$\frac{36}{84}$	$\frac{27}{72}$
4.	$\frac{27}{30}$	$\frac{15}{40}$	$\frac{28}{32}$	$\frac{15}{25}$	$\frac{9}{24}$	$\frac{27}{36}$	$\frac{49}{56}$	$\frac{35}{40}$
5.	$\frac{12}{18}$	$\frac{6}{9}$	$\frac{21}{35}$	$\frac{25}{30}$	$\frac{21}{24}$	$\frac{14}{14}$	$\frac{21}{27}$	$\frac{36}{42}$
6.	$\frac{24}{72}$	$\frac{8}{15}$	$\frac{2}{15}$	$\frac{2}{34}$	$\frac{24}{36}$	$\frac{25}{45}$	$\frac{12}{18}$	$\frac{40}{72}$
7.	$\frac{18}{60}$	$\frac{7}{35}$	$\frac{9}{15}$	$\frac{15}{18}$	$\frac{24}{48}$	$\frac{51}{60}$	$\frac{10}{12}$	$\frac{15}{25}$
8.	$\frac{27}{45}$	$\frac{15}{40}$	$\frac{12}{18}$	$\frac{14}{21}$	$\frac{6}{18}$	$\frac{3}{60}$	$\frac{12}{16}$	$\frac{20}{35}$
9.	$\frac{96}{144}$	$\frac{24}{44}$	$\frac{18}{27}$	$\frac{27}{30}$	$\frac{27}{45}$	$\frac{21}{35}$	$\frac{32}{44}$	$\frac{63}{72}$
10.	$\frac{17}{34}$	$\frac{12}{15}$	$\frac{22}{33}$	$\frac{44}{55}$	$\frac{25}{30}$	$\frac{45}{50}$	$\frac{17}{34}$	$\frac{8}{40}$

1. Change the fractions in each couplet to lowest terms, and then find the sum and the difference of each couplet.

2. Find the product of each couplet.

3. Divide the first term of each couplet by the second term.

4. Tell at sight what must be added to each of these numbers to make 100 :

$2\frac{1}{2}$ $3\frac{1}{2}$ $4\frac{1}{2}$ $6\frac{1}{2}$ $6\frac{3}{4}$ $8\frac{1}{2}$ $12\frac{1}{2}$
 $16\frac{3}{4}$ $33\frac{1}{2}$ $37\frac{1}{2}$ $62\frac{1}{2}$ $66\frac{3}{4}$ $83\frac{1}{2}$ $87\frac{1}{2}$

5. Find the sum and the difference of each of the above numbers and 50; 25; 75; $16\frac{3}{4}$; $33\frac{1}{2}$; $66\frac{3}{4}$; $83\frac{1}{2}$; $12\frac{1}{2}$; $87\frac{1}{2}$; $62\frac{1}{2}$; $87\frac{1}{2}$.

DECIMALS

- 1. Is a decimal a whole number or a fraction?**

A power of a number is the product obtained by using that number a specified number of times as a factor.

Thus, the second power of 10 is 10×10 , or 100.

- 2. What is the third power of ten?**

3. What power of 10 is represented by 10^4 ? What is the fourth power of 10?

- 4. What must the denominator of a decimal be?**

5. Write as decimals: $\frac{3}{10}$ $\frac{3}{100}$ $\frac{3}{1000}$ $\frac{3}{10000}$ $\frac{3}{100000}$

6. When a common fraction whose denominator is 10 or some power of 10 is expressed as a decimal, how is the number of decimal places determined?

7. Write as common fractions: .9 .09 .009 .0009
.00009

3. When a decimal is expressed as a common fraction, how is the denominator determined?

DECIMALS : NOTATION AND NUMERATION

	Tenths	Hundredths	Thousandths	Ten-thousandths	Hundred-thousandths	Millionths
Read:	3	2	8	6	5	7
1. .007	2. .0085		3. .0105		4. .12067	
5. .0102	6. .2008		7. .018246		8. .687259	

- | | | | |
|-----------|------------|-------------|-------------|
| 9. 35.96 | 10. 8171.6 | 11. 34.0207 | 12. 3.29018 |
| 13. 4.067 | 14. 810.05 | 15. 80070.8 | 16. 49230.7 |
| 17. 643.7 | 18. 3.4907 | 19. 640.048 | 20. 500.005 |

21. What is a mixed decimal?

Write in figures:

22. Thirty-seven hundredths.
23. Nine thousandths.
24. Forty-two ten-thousandths.
25. Seven hundred sixteen hundred-thousandths.
26. One hundred eighty and sixty-nine hundredths.
27. Five thousand forty-eight and six thousandths.
28. Seventy and sixty-one hundred thousandths.
29. Four hundred four thousandths.
30. Four hundred and four thousandths.
31. One hundred thousand one hundred and one hundredth.

DECIMAL AND FRACTIONAL EQUIVALENTS

Write as common fractions in their lowest terms:

- | | | | |
|-----------|-----------|-----------|-----------|
| 1. .35 | 2. .65 | 3. .85 | 4. .32 |
| 5. .48 | 6. .72 | 7. .56 | 8. .96 |
| 9. .64 | 10. .28 | 11. .84 | 12. .36 |
| 13. .125 | 14. .375 | 15. .225 | 16. .875 |
| 17. .625 | 18. .025 | 19. .075 | 20. .015 |
| 21. .0025 | 22. .0375 | 23. .0625 | 24. .0875 |
| 25. .0125 | 26. .425 | 27. .105 | 28. .275 |

Tell at sight the decimal equivalents of:

29. $\frac{1}{2}$ $\frac{1}{4}$ $\frac{3}{4}$ $\frac{1}{5}$ $\frac{2}{5}$ $\frac{3}{5}$ $\frac{4}{5}$ $\frac{1}{15}$ $\frac{2}{15}$ $\frac{2}{25}$

30. $\frac{1}{10}$ $\frac{2}{10}$ $\frac{7}{10}$ $\frac{9}{10}$ $\frac{1}{20}$ $\frac{3}{20}$ $\frac{11}{20}$ $\frac{1}{50}$ $\frac{3}{50}$ $\frac{9}{50}$

31. Change $\frac{7}{8}$ to a decimal. 32. Change $\frac{2}{3}$ to a decimal.

$$\begin{array}{r} 7 \\ 8 \overline{) 7.000} \\ \underline{.875} \end{array}$$

$$\begin{array}{r} 2 \\ 3 \overline{) 2.000} \\ \underline{.636\frac{2}{3}} \end{array}, \text{ or } .666\frac{2}{3}$$

Change to decimals:

33. $\frac{1}{8}$ 34. $\frac{1}{6}$ 35. $\frac{5}{8}$ 36. $\frac{5}{7}$ 37. $\frac{1}{8}$

38. $\frac{2}{3}$ 39. $\frac{5}{8}$ 40. $\frac{7}{8}$ 41. $\frac{1}{9}$ 42. $\frac{1}{11}$

43. $\frac{5}{12}$ 44. $\frac{1}{16}$ 45. $\frac{1}{24}$ 46. $\frac{1}{80}$ 47. $\frac{5}{32}$

48. $\frac{1}{40}$ 49. $\frac{1}{80}$ 50. $\frac{63}{64}$ 51. $\frac{75}{128}$ 52. $\frac{103}{256}$

.18, .625, .004 are pure decimals; $.16\frac{2}{3}$, $.01\frac{1}{7}$, $.006\frac{2}{3}$ are complex decimals.

53. What is a pure decimal? A complex decimal?

Since the denominator of a decimal is 10 or some power of 10, the only common fractions that can be expressed as pure decimals are those whose denominators, when the fractions are in their lowest terms, contain only the factors 2 or 5.

54. Name five fractions that can be changed to pure decimals; five that cannot be changed to pure decimals.

$.6\frac{1}{2}$ means 6 tenths and $\frac{1}{2}$ of a tenth, and may be written .65.

Write as pure decimals:

55. $.2\frac{1}{5}$ 56. $.4\frac{1}{4}$ 57. $.3\frac{3}{5}$ 58. $.1\frac{1}{4}$ 59. $.7\frac{3}{4}$

60. $.8\frac{1}{5}$ 61. $.2\frac{1}{8}$ 62. $.4\frac{3}{8}$ 63. $.6\frac{5}{8}$ 64. $.3\frac{1}{4}$

DECIMALS: ADDITION

Write in decimal form and find the sum of:

1. $3\frac{67}{100}$, $45\frac{881}{10000}$, $12\frac{1}{10}$, $26\frac{87}{1000}$, $5\frac{8}{100}$.

2. $24\frac{7}{10}$, $\frac{16}{1000}$, $3\frac{7}{10000}$, $37\frac{84}{100}$, $100\frac{1}{100}$.

3. $\frac{9}{10}$, $\frac{8}{100}$, $\frac{8}{1000}$, $\frac{8}{10000}$, $\frac{8}{100000}$.

4. $\frac{7}{10}$, $\frac{777}{10000}$, $\frac{7777}{100000}$, $\frac{77}{100}$, $\frac{7777}{100000}$.

Find the sum of:

5. 43.9, 65.4, 1.98, .412.

6. 1.07, 5.002, 37.6, .308.

7. .006, .08, .0007, .9.

8. 4.875, 6.375, 12.08, 17.016.

9. 43.225, 17.906, 10.017, 3.916.

10. .0007, .0165, .904, .8, .217.

11. 156.28, 375.009, 67.803, .0805.

12. .1, 8.03, 7.005, 8.0007, 5.00009.

13. 7 hundredths; 15 thousandths; 65 hundredths;
5 tenths; 8 ten-thousandths.

14. 95 ten-thousandths; 389 thousandths; 265 ten-thousandths.

15. Six hundred and six thousandths; eight hundred and four tenths; seventy and eighty-six ten-thousandths.

16.

.7854

17.

25.256

18.

240.24

19.

371.876

.10842

102.102

37.1

90.84

.98003

6708.00093

1259.008

27.3071

.500004

812.0104

760.00716

19.0008

.70063

73.0016

15.005

1024.01018

DECIMALS: SUBTRACTION

Subtract at sight :

1. $\begin{array}{r} 2.4 \\ .7 \\ \hline \end{array}$	2. $\begin{array}{r} 6.8 \\ .9 \\ \hline \end{array}$	3. $\begin{array}{r} .47 \\ .12 \\ \hline \end{array}$	4. $\begin{array}{r} .007 \\ .005 \\ \hline \end{array}$	5. $\begin{array}{r} .0075 \\ .002 \\ \hline \end{array}$
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6. $\begin{array}{r} 2.75 \\ 1.5 \\ \hline \end{array}$	7. $\begin{array}{r} 3.50 \\ 3.25 \\ \hline \end{array}$	8. $\begin{array}{r} 3.7 \\ 2.8 \\ \hline \end{array}$	9. $\begin{array}{r} 5.8 \\ .9 \\ \hline \end{array}$	10. $\begin{array}{r} .02 \\ .002 \\ \hline \end{array}$
---	--	--	---	--

11. From 1 take .5; .25; .75; .42; .67.

12. From 1 take .1; .01; .001; .0001.

13. From 4 take 1.25; 1.5; 1.75; 1.05.

14. From .5 take .25; .05; .49; .025.

15. From 10.1 take 10; .1; 1.1; 1.01; 5.5.

16. $\begin{array}{r} 12.42 \\ 7.09 \\ \hline \end{array}$	17. $\begin{array}{r} 7.645 \\ .409 \\ \hline \end{array}$	18. $\begin{array}{r} 6.85 \\ .57 \\ \hline \end{array}$	19. $\begin{array}{r} .909 \\ .0909 \\ \hline \end{array}$
--	--	--	--

20. $\begin{array}{r} .807 \\ .69 \\ \hline \end{array}$	21. $\begin{array}{r} .073 \\ .0085 \\ \hline \end{array}$	22. $\begin{array}{r} .005 \\ .0027 \\ \hline \end{array}$	23. $\begin{array}{r} .68 \\ .0375 \\ \hline \end{array}$
--	--	--	---

24. From eight and seventy-five hundredths take ninety-two hundredths.

25. From sixty-seven hundredths take seventy-nine thousandths.

26. Find the difference between sixty-two and eight hundredths, and twelve and eighty-six thousandths.

27. Subtract twenty-six thousandths from two and five-tenths.

28. Take ten and one hundredth from one hundred and one tenth.

29. Subtract three hundredths from three hundred.

30. From two hundred two take two hundred two thousandths.

31. By how much is one hundred and one hundredth greater than one hundred one hundredths?

DECIMALS: MULTIPLICATION

1. 34.6 multiplied by 10 =

2. 34.6 multiplied by 100 =

3. 34.6 multiplied by 1000 =

4. 34.6 multiplied by 10000 =

5. 34.6 multiplied by .1 =

6. 34.6 multiplied by .01 =

7. 34.6 multiplied by .001 =

8. 34.6 multiplied by .0001 =

9. Tell how to multiply by 10. By 100. By 1000. By 10,000.

10. Tell how to multiply by .1. By .01. By .001. By .0001.

11. Express 648 dollars as cents; 2750 cents as dollars. Multiply:

12. \$0.2475 by 10; by 100; by 1000; by 10,000.

13. \$9625 by .1; by .01; by .001; by .0001.

14. 375 by .1

15. 468.2 by 10

16. 14.76 by 10

17. 3.462 by 100

18. 13.459 by .01

19. 293.08 by .1

20. 7.696 by .001

21. 172.8 by 1000

22. 48,700 by .01

23. 470.06 by .01

24. 13.629 by .1

25. 34,000 by .001

26. $\frac{7}{10} \times \frac{7}{10} = .7 \times .7 =$

27. $\frac{7}{100} \times \frac{7}{10} = .07 \times .7 =$

28. $\frac{7}{100} \times \frac{7}{100} = .07 \times .07 =$

29. How many decimal places in the product of $.6 \times .7$?
In the product of $.07 \times .7$? In the product of $.07 \times .07$?

30. Tell how to point off the product in the multiplication of decimals.

Multiply:

31. 3068 by .8

32. 60.5 by 2.7

33. 12.56 by .06

34. 6.05 by 6.02

35. 684.7 by .15

36. 3.72 by 1.1

37. .008 by 6.7

38. 92.43 by 1.8

39. 3.1416 by 75

40. .7854 by 55

41. .0606 by 3.6

42. 37.856 by 1000

43. .093 by .07

44. .008 by .055

45. 376.04 by 1.05

46. 12.75 by .032

47. 3025 by .098

48. .318 by 2.75

49. .03 by 3600

50. .007 by .005

51. 4.0804 by 5.05

52. 462.07 by .08

53. 36.036 by 12.3

54. 378.5 by 1.35

55. .009 by .072

56. .55 by 5.5

57. 66.3 by .064

58. .00808 by 1000

59. 1428 by .139

60. 4.096 by .045

61. .015 by 200.2

62. .1504 by 8.08

63. .505 by 80.8

64. .375 by 4400

65. .0213 by 6.8

66. 3.03 by .0207

67. $.0825$ by $.026$

68. 36.84 by $.0105$

69. 6728 by $.0005$

70. $.0064$ by 29

71. $.00086$ by 295

72. 27.004 by $.025$

73. 1.032 by 8.8

74. 63860 by $.075$

75. $.0075$ by $.044$

76. Multiply $\$2.40$ by 500 .

$\$2.40$ multiplied by $100 = \$240$; $\$240$ multiplied by $5 = \$1200$.

77. Multiply $\$2.40$ by $.05$.

$\$2.40$ multiplied by $.01 = \$0.024$; $\$0.024$ multiplied by $5 = \$0.12$.

Multiply:

78. $\$26$ by 200

79. $\$18.60$ by 20

80. $\$16.50$ by 30

81. $\$36$ by $.5$

82. $\$22.25$ by $.2$

83. $\$12.75$ by $.4$

84. $\$32.50$ by 300

85. $\$12.25$ by 400

86. $\$1.25$ by 600

87. $\$75$ by $.6$

88. $\$3.50$ by $.02$

89. $\$42.50$ by $.08$

90. $\$16$ by $.3$

91. $\$810$ by $.07$

92. $\$3600$ by $.002$

93. $\$4800$ by $.005$

DECIMALS: DIVISION

Test these divisions:

1. $7 \overline{) .56}$
 $.08$

2. $4 \overline{) .032}$
 $.008$

3. $5 \overline{) .4}$
 $.08$

4. $6 \overline{) .054}$
 $.009$

5. $4 \overline{) .02}$
 $.005$

6. Find the quotient of (1) $.64 \div .2$; (2) $.056 \div .07$;
(3) $824 \div 2.06$.

(1) $.2 \overline{) .64} = 2 \overline{) 6.4}$
 3.2

(2) $.07 \overline{) .056} = 7 \overline{) 5.6}$
 $.8$

(3) $2.06 \overline{) 824} = 206 \overline{) 82400}$
 400

7. Tell what change was made in each of the above examples before dividing.

When the divisor contains a decimal, make the divisor a whole number by multiplying both divisor and dividend by 10, 100, 1000, etc.

In dividing a decimal by a whole number, the decimal point in the quotient stands in the same column as the decimal point in the dividend.

The first step in division of decimals is to write the decimal point in the quotient.

Solve at sight:

8. $4.8 \div 6$

9. $.24 \div 4$

10. $.045 \div 5$

11. $56 \div .7$

12. $2.7 \div .8$

13. $.54 \div .9$

Divide:

14. .085 by 17

15. .0096 by 8

16. .0027 by 18

17. 7.02 by 6.5

18. .308 by .35

19. 551.2 by 2.08

20. 44.64 by 2.88

21. 633.6 by 6.4

22. .06 by .001

23. 15.129 by 12.3

24. 204 by .085

25. 262.5 by 5.25

26. 22.5 by 1800

27. 130.8 by .01

28. 30.03 by .003

29. 671 by .305

30. 70.62 by 160.5

31. 1943.5 by .25

32. .08181 by 9.09

33. .1728 by 48

34. 1728 by .96

35. 525.6 by .36

36. 63.36 by .32

37. 156.6 by .58

38. .4662 by 74

39. 2.7202 by 58

40. .2546 by .67

41. .8892 by 247

42. .138 by 276

43. 346.56 by 6.08

- | | |
|--------------------|---------------------|
| 44. 408 by .017 | 45. 186.02 by 100 |
| 46. 3.92 by .056 | 47. 15.04 by .08 |
| 48. 9.09 by .003 | 49. 43.008 by 4.096 |
| 50. 14.124 by 32.1 | 51. 56.088 by 123 |
| 52. 13.31 by .011 | 53. .0576 by .36 |
| 54. .0084 by .035 | 55. .03648 by .006 |
| 56. .0616 by .007 | 57. .0432 by 36 |

WRITTEN PROBLEMS

X1. A farmer sold five loads of hay weighing as follows: .45 ton, .625 ton, .54 ton, .375 ton, and $\frac{1}{4}$ ton. How many tons did he sell?

X2. The sides of an irregular field measure 30.65 rods, 42.15 rods, 18.07 rods, 19.05 rods, 20.02 rods, 17.024 rods. How many rods less than a mile (320 rods) is the distance around the field?

X3. From a hogshead of molasses containing 84 gallons there are drawn 6.5 gallons, 12.75 gallons, 15.625 gallons, 20 gallons, .75 gallon, and 3.25 gallons. How many gallons are left?

4. Mr. Brown sold land as follows: .78 acre, $\frac{1}{2}$ acre, $6\frac{3}{4}$ acres, $.87\frac{1}{2}$ acre, and $7\frac{1}{2}$ acre. How many acres did he sell?

5. The statute knot used in measuring distances on the sea is 1.151 miles. What is the speed in miles of a steamship making 20.5 knots an hour?

6. How long a bolt will be required to fasten together two planks, one 3.5 inches thick and the other 2.25 inches thick, allowing .375 of an inch for the head of the bolt and .375 of an inch for the nut?

(7.) A surveyor finds the length of a schoolhouse lot to be 69.85 yards. Express the length in rods. (5.5 yards make 1 rod.)

(8.) How many yards in 82.3 rods?

(9.) The French franc is worth 19.3 cents. Five francs are how much less than a United States dollar?

(10.) How many French franc pieces are equal to \$3.86 in our money?

(11.) At the rate of .9 of a dollar per thousand cubic feet, Mr. Wilson's gas bill for November was \$3.15. How many thousand cubic feet were used?

(12.) A bushel of wheat occupies 1.25 cubic feet of space. How many bushels will a bin hold whose capacity is 52.5 cubic feet?

(13.) The English pound sterling is worth \$4.8665 in United States money. Five English pounds sterling are worth how much less than 5 5-dollar United States gold pieces?

(14.) A quart of water weighs 2.08 pounds (nearly). What is the weight of the water in a kettle holding 2.5 gallons?

(15.) Milk is 1.03 times as heavy as water. What is the weight of a gallon of milk?

(16.) A clerk in a store receives \$2.50 a day. The head of the department receives .2 more, and the errand boy .4 as much as the clerk. How much does the head of the department receive? How much does the boy receive?

(17.) How many yards of cloth in 36 bolts of 40.75 yards each?

DRILL EXERCISE

	A	B	C	D	E
1.	$\frac{1}{8}$	$\frac{2}{8}$	$\frac{1}{2}$	$\frac{2}{4}$	$\frac{2}{16}$
2.	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{8}$	$\frac{2}{8}$
3.	$\frac{1}{6}$	$\frac{7}{10}$	$\frac{2}{50}$	$\frac{20}{25}$	$\frac{7}{100}$
4.	$\frac{1}{2}$	$\frac{2}{4}$	$\frac{7}{10}$	$\frac{1}{16}$	$\frac{2}{20}$
5.	$\frac{1}{10}$	$\frac{2}{5}$	$\frac{1}{8}$	$\frac{48}{50}$	$\frac{1}{40}$

1. At sight, subtract each fraction from 10.
2. Find the sum of each column; of all the columns.
3. Find the sum of each row; of all the rows.
4. Make a table similar to that above, expressing each fraction as a decimal.
5. Find the sum of each column; of all the columns.
6. Find the sum of each row; of all the rows.

COUNTING

Oral

12 units	= 1 dozen (doz.)
12 dozen	= 1 gross (gr.)
20 units	= 1 score
24 sheets of paper	= 1 quire
20 quires	= 1 ream

500 sheets are frequently called a ream.

Paper is quite generally sold by the pound.

1. How many dozen in 75 eggs? In 100 eggs?
2. How many oranges in $3\frac{1}{2}$ dozen? In $2\frac{1}{2}$ dozen?

3. Compare a dozen with a score. A score with a dozen.
4. How old is a man who is "threescore years and ten"?
5. How many score in a century?
6. At 2 cents each, how much will a gross of pencils cost?
7. How many gross of pencils in 8 boxes of 6 dozen each?
8. How many sheets in a ream?
9. How many envelopes must be bought to match $2\frac{1}{2}$ quires of letter paper?
10. What is the cost of $\frac{1}{4}$ of a ream of paper at 20 cents a quire?
11. At \$2 a ream, what is the cost of 6 quires of paper?

LINEAR MEASURE

1. Repeat the table of linear measure.
2. 1 mile = — rods = — yards = — feet = — inches.
3. What are the dimensions in feet of a house lot 2 rods by 4 rods? What is the perimeter of the lot in feet?
4. Express as parts of a mile the dimensions of a lot 80 rods by 40 rods. Express its perimeter in miles.
5. A fathom is 6 feet. A cable length is 120 fathoms. A ship is anchored 3 cable lengths from shore in $15\frac{1}{2}$ fathoms of water. Express distances in feet.
6. Noah's ark was 300 cubits long, 50 cubits wide, and 30 cubits high. A sacred cubit is 1.824 feet. Give the dimensions in feet.

7. A military pace is $2\frac{1}{2}$ feet. At 120 paces a minute, how long will it take a regiment to march a mile?

8. How many feet of wire must be used in building a framework for grapevines, if there are 4 rows, each 3 rods long and 6 wires high?

9. How many rails 30 feet long will be required to lay a railroad track $\frac{1}{2}$ of a mile long?

10. An aviator reaches a height of 11,474 feet. Express the height in miles.

11. A stone contractor agreed to furnish 280.5 feet of curbing at \$14.20 per rod. What was the total price?

12. Five house lots side by side measure, respectively, 70 ft. 6 in., 62.75 ft., 4 rd., $22\frac{1}{4}$ yd., and $57\frac{1}{2}$ ft. What is the total frontage in feet?

13. A map is drawn on a scale of 1" to $37\frac{1}{2}$ miles. What is the distance between two places $3\frac{1}{8}$ inches apart?

14. On another map, $\frac{1}{4}$ " represents 1 rod. How many feet does a line 1' 3" long represent?

15. Letting 1" represent 160 rods, draw a line to represent the distance between two places $1\frac{1}{4}$ miles apart.

16. A contractor who was to build a piece of railroad track $2\frac{3}{16}$ miles long was obliged to stop work after completing 525 rods. What part of the work was unfinished?

17. At \$4.92 per bale of 20 rods, how much must Mr. Jenkins pay for the wire fencing necessary to inclose his pasture, 14 rods long and 6 rods wide?

SQUARE OR SURFACE MEASURE

Write the table of square measure.

1 acre = — square rods = — square yards =
— square feet = — square inches.

The area of a figure is the number of square units it contains.

The figure represents a surface 4 feet long and 1 yard wide. What is its area? A surface 4 feet by 1 yard is a surface 4 feet by 3 feet. The shaded part represents the unit of measurement, — 1 square foot.

If the figure were 4 feet long and 1 foot wide, it would contain how many square feet? Since it is 3 feet wide, it contains 3 times 4 square feet, or 12 square feet.

Steps taken:

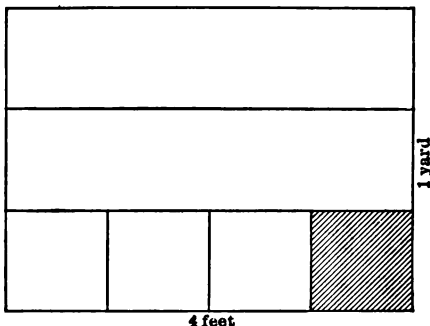
First. Determine the unit of measurement.

Second. Find the number of these units in one row.

Third. Multiply the number of units in one row by the number of rows.

Short method : $3 \times 4 = 12$.

In finding areas the dimensions must be expressed in the *same* unit of measurement (inches, feet, yards, etc.).



PROBLEMS

Oral

1. What measurements must be made to find the area of one side of a sheet of examination paper? How is the area found?

2. Remembering that the multiplier is an abstract number simply showing how many times, explain just how to find the area of a piece of paper 8 in. long and 6 in. wide.

3. A geography covers 96 square inches on the table. It is 8 inches wide. How long is it?
4. A field is 9 rods long and $\frac{2}{3}$ as wide. What is its area? What is its perimeter?
5. One board is 16 in. by 4 in. Another is 8 in. square. Compare their areas. Compare their perimeters.
6. The area of a square lot is 49 square rods. What is its perimeter?
7. The perimeter of a square lot is 48 rods. What is its area?
8. A field is 8 rods long. It contains 32 square rods. How many rods of fence will inclose it?
9. What is meant by 2 square inches?
10. What is meant by a 2-inch square?
11. Mr. Chase has two square fields. One contains 64 square rods. The distance around the other is 64 rods. Compare their areas. Compare their perimeters.

PROBLEMS

Written

1. What are the dimensions in feet of a 12-inch square? What is its perimeter in feet? Its area in square feet?
2. Make and fill out a table like the following:

SQUARES	DIMENSIONS IN FEET	PERIMETER IN FEET	AREA IN SQUARE FEET
12-inch 24-inch 36-inch	1 foot	4 feet	1 square foot

Continue with 48-inch, 60-inch, 72-inch, 84-inch, 96-inch, 108-inch, 120-inch, 132-inch, 144-inch squares.

3. Mr. James has a lot of land containing 16 square rods. Express its area in acres.

4. Mr. Brown has a lot that is 16 rods square. Express its area in acres.

5. A lot 108 ft. by 75 ft. is sold at $12\frac{1}{2}$ cents a square foot. How much is received for it?

6. A lot of land is 66 feet wide and $1\frac{1}{2}$ times as long.
(1) How many rods of fence will be required to inclose it? (2) What is the value of the lot at 18 cents a square foot?

7. How many feet of weather molding are necessary for a door 6' 10" by 3' 4"? What is the area of the opening when the door is wide open?



Find the number of acres in lots of these dimensions:

LENGTH	WIDTH	LENGTH	WIDTH
8. 52 rd.	24 rd.	9. 60 rd.	60 rd.
10. $20\frac{1}{2}$ rd.	18 rd.	11. $12\frac{1}{2}$ rd.	$10\frac{1}{2}$ rd.
12. $1\frac{7}{8}$ rd.	$1\frac{1}{8}$ rd.	13. $3\frac{1}{8}$ rd.	$3\frac{1}{8}$ rd.
14. 4.8 rd.	2.25 rd.	15. $\frac{1}{2}$ rd.	$\frac{1}{2}$ rd.
16. 369 ft.	110 ft.	17. 440 ft.	396 ft.
18. 24 rd.	24 rd.	19. 25.5 rd.	25.5 rd.



20. Find the perimeters of the lots in examples 8 to 19.

21. A lot containing 2 A. 112 sq. rd. was cut up into 18 equal house lots. How many square rods in each lot?

22. Mr. Jackson paid \$8000 for a lot 40 rd. by 30 rd. At the same rate what ought he to pay for another lot one half as long and one half as wide?

(23.) The garden of the Harvard school is 80 ft. by 60 ft. Each pupil has a plot 10 ft. by 5 ft. Allowing one sixth of the whole area for paths, how many individual gardens are there?

Find the areas of the following rectangles :

	LENGTH	WIDTH		LENGTH	WIDTH
24.	18'	12'	25.	15 in.	12½ in.
26.	20'	15'	27.	24 ft.	18 ft. 6 in.
28.	16' 6"	14' 6"	29.	7½ ft.	7½ ft.
30.	1¾"	1¾"	31.	¼ rd.	4½ yd.
32.	1' 6"	¾'	33.	4½ ft.	20 in.
34.	3' 3"	2' 6"	35.	48 ft.	15 yd.
36.	1¾'	1¾'	37.	60 yd.	40 yd. 2 ft.
38.	1' 8"	1' 3"	39.	½ yd.	½ ft.
40.	15' 6"	14'	41.	15¾ ft.	15¾ ft.
42.	12' 8"	10' 6"	43.	1.2 rd.	7.75 yd.

44. Express the perimeters of the above rectangles in inches, feet, or yards, as directed.

(45.) If you were given your choice of three lots — 36 rd. by 9 rd., 27 rd. by 12 rd., and 18 rd. by 18 rd. — on condition that you pay for fencing, which would you choose?

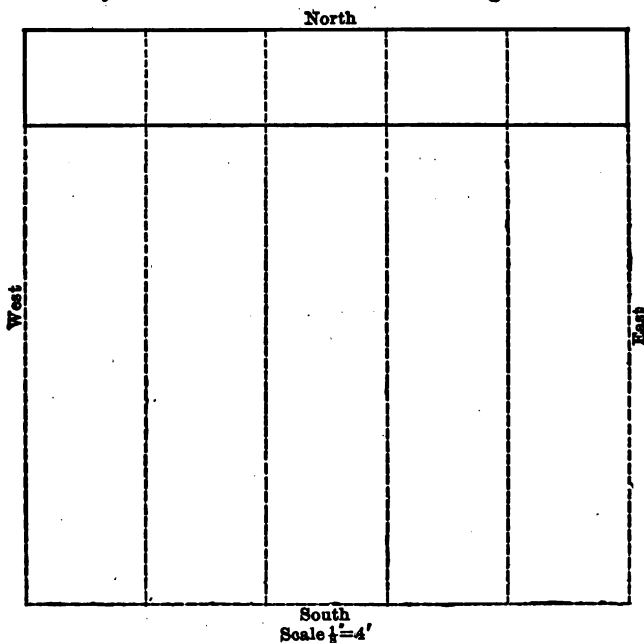
(46.) The cost of fencing a lot at 22 cents per foot was \$73.92. What was the perimeter of the lot?

(47.) A chess board is 8 squares long and 8 squares wide. Each square is 1½ inches long. What is the area of the board? The distance around its edge?

48. What is the area of a table 2 ft. 8 in. by 2 ft. 8 in.?

A POULTRY HOUSE AND YARDS

The diagram represents the ground plan of a poultry house and yards. Dotted lines show fencing.



Find:

1. The area covered by the house; by each compartment; the number of square feet of floor space to a fowl if there are 50 in a compartment.
2. The area of all the yards; of each yard; the yard space allowed to each fowl.
3. The total area covered by house and yards; the part of the total area covered by the house; by the yards.

4. The number of feet of fencing required ; the number of rods.

5. The number of 5-rod bales of fencing that must be bought and the cost at \$1.60 per bale. (The dealer will not sell a part of a bale.)

6. The number of posts required to support the netting about the yards if placed 10 feet apart on the south side and 8 feet apart on the lines running north and south, if the netting is fastened directly to the house.

7. The cost of the posts at 13 cents each ; total cost of netting and posts.

USE OF SIGNS

1. What operations must be performed first in solving:

$$36 + 2 + 3 \times 2?$$

$$\text{In } 20 - 4 \times 2 + 6 + 3?$$

$$24 + 2 + 4 = 12 + 4 = 16.$$

$$24 + (2 + 4) = 24 + 6 = 4.$$

When several terms are inclosed in a parenthesis, solve the part in parenthesis first.

Solve :

$$2. 13 + 3 \times 2.$$

$$3. (13 + 3) \times 2.$$

$$4. 16 - 2 \times 4.$$

$$5. (16 - 2) \times 4.$$

$$6. 12 + 8 + 4.$$

$$7. (12 + 8) + 4.$$

$$8. 35 + 5 + 2.$$

$$9. 35 + (5 + 2).$$

$$10. 48 + 2 + 4 - 3.$$

$$11. 48 + (2 + 4 - 3).$$

Brackets, [], braces, { }, and the vinculum, $\overline{\quad}$, have the same force as the parenthesis.

$$12. 24 + 6 - 2.$$

$$13. 24 + [6 - 2].$$

$$14. 24 \times 2 + 4.$$

$$15. 24 \times \{2 + 4\}.$$

$$16. 48 + 12 + 4.$$

$$17. 48 + \overline{12 + 4}.$$

$$18. 36 + \overline{3 + 3} - 3 \times 2.$$

$$19. 60 + (10 + 5) + 8 \times 3.$$

20. Show that $83 - 5 \times 4$ is equal to $(10 + 11) \times 3$.
21. Which is greater, $4 + 8 \times 5$ or $\overline{4 + 8} \times 5$?
22. What is the sum of $54 + 6 + 12$ and $54 + (6 + 12)$?
23. How many times is $42 + \overline{2 + 4}$ contained in $(32 - 4) \times 2$?
24. If $54 + (6 \times 9)$ is taken from $54 + 6 \times 9$, what is left?
25. What is the product of $20 \times 3 + 3$ and $20 \times \overline{3 + 3}$?
26. Divide $\overline{40 - 8} \times 2$ by $15 \times 2 + 2$.
27. Find the sum, difference, product, and quotient of $56 + 98 + 14 - 2 \times 1\frac{1}{2}$ and $\overline{56 + 98} + 14 - 2 \times 1\frac{1}{2}$.

QUADRILATERALS

1. What is a quadrilateral?

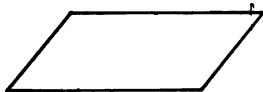
PARALLELOGRAMS



Rectangle



Square



~~Rhomboid~~



~~Rhombus~~
Diamond

2. What name is given to quadrilaterals having two pairs of parallel sides?
3. Name the different kinds of parallelograms.
4. Describe a rectangle. A square. A rhomboid. A rhombus.

NOTE. Any correct description should be accepted. The main thing is to be sure that pupils distinguish clearly the different figures.

5. What is the altitude of a parallelogram?

6. Tell how to find the area of a rectangle. Of any parallelogram.



TRAPEZOID

7. What name is given to quadrilaterals having one pair of parallel sides?

8. What is the altitude of a trapezoid?

9. Draw a trapezoid on paper. Cut it out and fold so that the parallel sides coincide. Cut along the crease; arrange the parts to form a parallelogram. What is the base of the parallelogram? Its area? What is the area of the trapezoid?

The area of a trapezoid is equal to one half the product of its altitude and the sum of its parallel sides.

Find the areas of trapezoids of these dimensions:

PARALLEL SIDES	ALTITUDE
10. 20 in. and 12 in.	8 in.
$\frac{(20 + 12) \times 8}{2} =$	
X 11. 16 in. and 18 in.	9 in.
X 12. 18 in. and 15 in.	10 in.
X 13. 32 ft. and 10 ft.	12 ft.
X 14. 1 ft. 8 in. and 1 ft.	16 in.
X 15. 2 ft. 8 in. and 1 ft. 4 in.	1 ft. 6 in.
16. 8.8 ft. and 16 ft.	1.5 ft.
17. 6.75 ft. and 4.25 ft.	3 ft.
18. $12\frac{3}{4}$ ft. and $8\frac{3}{4}$ ft.	6 ft.
19. $18\frac{1}{8}$ ft. and $16\frac{3}{8}$ ft.	$8\frac{1}{2}$ ft.

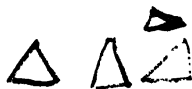
20. What name is given to quadrilaterals having no two sides parallel?

21. Draw a trapezium; draw one of its diagonals. Cut out the trapezium; separate it into two triangles by cutting along the diagonal. Find the area of each triangle. Of both triangles. What is the area of the trapezium?



22. Tell how to find the area of a trapezium.

23. Draw other trapeziums and find their areas.

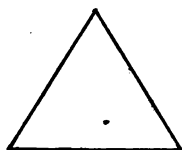


TRIANGLES

1. What is a triangle?

Triangles compared :

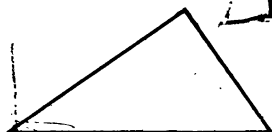
I. With respect to their sides.



EQUILATERAL



ISOSCELES



SCALENE

2. Describe an equilateral triangle.

3. What is the perimeter of an equilateral triangle, whose sides are each 7 inches? $2\frac{1}{2}$ inches? $3\frac{3}{4}$ inches? $12\frac{1}{2}$ rods?

4. The perimeter of an equilateral triangular flower bed is $16\frac{1}{2}$ feet. What is the length of one side?

5. Describe an isosceles triangle.

6. What is the perimeter of an isosceles triangle whose equal sides are each 6 feet and whose base is 4 feet?

7. The perimeter of an isosceles triangle is 20 inches ; its base is 6 inches. What is the length of each of the other sides ?

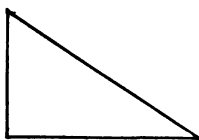
8. The base of an isosceles triangle is $2\frac{1}{2}$ rods ; one of the equal sides is $5\frac{1}{4}$ rods. What is the perimeter ?

9. Describe a scalene triangle.

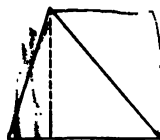
10. The sides of a scalene triangle are $8\frac{1}{2}$ inches, $5\frac{3}{4}$ inches, and $6\frac{1}{2}$ inches, respectively. Find the perimeter.

11. The perimeter of a scalene triangle is $20\frac{1}{2}$ yards. Two sides are, respectively, 30 feet and 12 feet. Find the third side.

II. With respect to their angles.



RIGHT-ANGLED



ACUTE-ANGLED



OBTUSE-ANGLED

12. Describe a right-angled triangle. An acute-angled triangle. An obtuse-angled triangle.

13. What is the altitude of a triangle ?

FINDING AREAS OF TRIANGLES



FIGURE 1

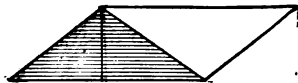


FIGURE 2

1. Tell how to find the area of figure 1. Of the shaded part. Of the shaded part of figure 2.

The area of a triangle is equal to one half the product of its base and its altitude.

2. What is the area of a triangular piece of cardboard whose base is $6\frac{1}{2}$ inches and whose altitude is $3\frac{1}{2}$ inches?

3. A patchwork bedspread is made up of 378 pieces, each in the shape of a right-triangle, whose base is 4 inches and whose altitude is 4 inches. How many square feet does it cover? How many square yards?

4. The two short sides of a corner cupboard are each 1 foot 8 inches, inside measurement. What is the area of the bottom shelf?

5. Mr. Jamieson has a wood lot in the shape of a triangle. One side is 40 rods, and the shortest distance from this side to the opposite angle is 36 rods. How many acres in the lot?

6. A farmer has a triangular pasture whose sides are each 80 rods. How much will it cost to fence it with wire fencing at \$2.88 per bale of 10 rods?

7. The distance from the middle of one of the sides to the opposite angle of the pasture in problem 6 is 89.44 rods. What is the area in square rods? In acres?

ORAL EXERCISES

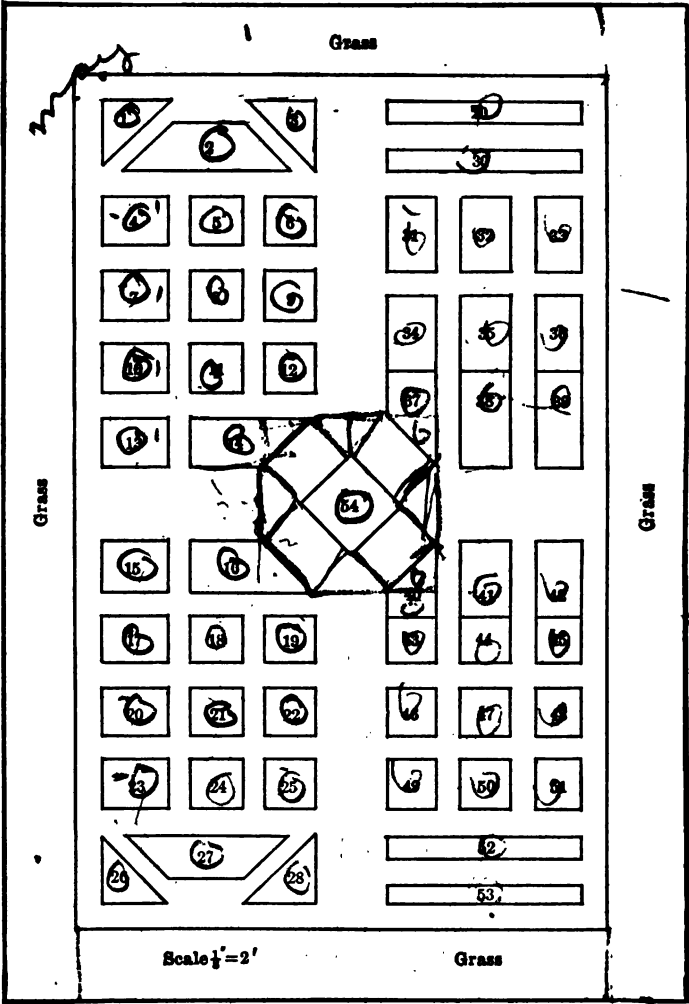
1. Find the cost per dozen when the price of one is: $6\frac{1}{4}^c$ $\$ \frac{1}{2}$ $37\frac{1}{2}^c$ \$1.25 $\$ 1\frac{1}{2}$ $\$ 2\frac{1}{2}$

2. Find the price of one when the cost per dozen is: 60^c 40^c $\$ \frac{1}{2}$ \$1.08 \$20 \$37.50

3. Find the rate per dozen when 4 articles are sold for 15^c ; 6 for 75^c ; 3 for 10^c ; 2 for \$1.25; 8 for 20^c .

4. Tell the price of one when the cost per hundred is: \$3 \$2.50 $\$ 1\frac{1}{2}$ \$8.50 \$40 \$50

THE JEFFERSON SCHOOL GARDEN



The garden is planted as follows:

FLOWERS

Asters (pink), 12, 19.
Asters (purple), 4, 23.
Asters (white), 6, 25, 10, 17.
Daisies, 7, 20.
Foliage plants, 54.
Forget-me-nots, 9, 22.
Geranium (red), 2, 27.

Nasturtiums, 13, 15
Pansies, 14, 16.
Poppies, 8, 21.
Shrubs, 1, 3, 26, 28.
Sweet Peas, 5, 24.
Violets, 11, 18.

VEGETABLES

Beans, 36, 51.
Beets, 39, 45.
Cabbages, 35, 50.
Carrots, 37, 40.
Celery, 30.

Cucumbers, 42.
Lettuce, 34, 46.
Onions, 32, 44.
Parsley, 49.
Parsnips, 48.

Potatoes, 38, 41.
Squashes, 52.
Sweet corn, 29, 53.
Tomatoes, 33, 47.
Turnips, 31, 43.

NOTE. The following exercise may be assigned for home work.

Copy the plan of the garden on a scale of $\frac{1}{4}$ " to 2".
Write in each plot its area as found.

1. The garden is in the form of what figure? What are its dimensions? Its area?

2. At $1\frac{1}{2}$ ¢ a foot, how much will it cost to inclose the garden with a wire fence?

3. Find the area covered by the grass plot.

THE FLOWER GARDEN

4. What is the shape of the bed of foliage plants? Its area? Give the numbers of other plots of the same shape.

5. What name is given to the plots devoted to shrubs? Find the area of each plot. Of all.

6. What is the shape of the beds of red geraniums? The area of each? Of both?

7. Of what shape are the beds of pansies? What is the area of each? Of both?

8. Of what shape are the beds of purple asters? What is the area of each? Give the numbers of all other beds of the same shape and area.

9. Find the area devoted to pink asters; to white asters; to daisies; to forget-me-nots; to nasturtiums; to poppies; to sweet peas; to violets.

10. Find the total area of the flower beds.

THE VEGETABLE GARDEN

11. Find the difference in area of the two plots of potatoes. The area of both plots.

12. What is the total area devoted to onions?

13. Of what shape are the plots of carrots? What is the area of each plot? Of both?

14. Of what shape are the patches of sweet corn? The area of each?

15. Find the area devoted to beans; to beets; to cabbages; to celery; to cucumbers; to lettuce; to parsley; to parsnips; to squashes; to tomatoes; to turnips.

16. At $\frac{1}{2}$ ¢ a foot, how much will it cost to place wire netting around the cucumber and the squash beds?

17. Find the total area of the vegetable beds.

THE WHOLE GARDEN

18. Find the total area of flower and vegetable beds.

19. Find the total area of garden and grass plots.

20. From the answers to problems 1 and 19, find the area covered by paths.)

PLASTERING

Plastering is usually estimated by the square yard.

In estimating work to be done, every contractor follows a rule which experience has taught him to be reliable. The general custom is to deduct from the total area of the walls and ceiling one half the area of openings, reckoning to the nearest yard.

In solving problems, make your practice in regard to methods and prices conform to local conditions. Builders are always willing to furnish any information desired.

1. How many square yards in the walls and ceiling of a room 21 ft. long, 18 ft. wide, and 12 ft. high?

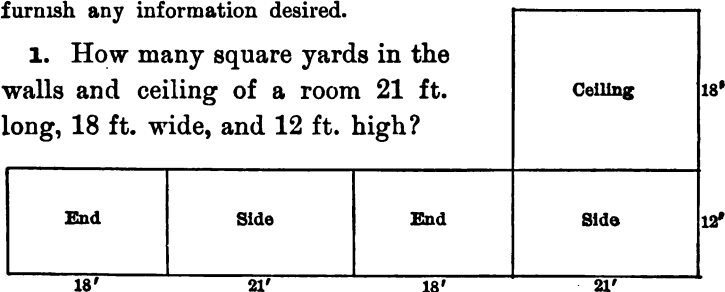


DIAGRAM OF WALLS AND CEILING

This may be illustrated by a pasteboard box without cover.

The walls form a rectangle whose length is the perimeter of the room. What are the dimensions of the rectangle formed by the walls? By the ceiling?

$$78 \times 12 = 936, \text{ no. of sq. ft. in walls}$$

$$21 \times 18 = 378, \text{ no. of sq. ft. in ceiling}$$

$$1314, \text{ no. of sq. ft. in walls and ceiling}$$

$$9 \overline{)1314}$$

$$146, \text{ no. of sq. yd. in walls and ceiling}$$

Find the number of square yards in the walls and ceiling of the following rooms, reckoning to the nearest square yard:

LENGTH	WIDTH	HEIGHT	LENGTH	WIDTH	HEIGHT
2. 16 ft.	12 ft.	8 ft.	3. 17'	15'	9'
4. 20 ft.	18 ft.	12 ft.	5. 18'	16'	9½'
6. 15 ft.	15 ft.	9 ft.	7. 18' 6"	16'	10'
8. 30 ft.	28 ft.	12 ft.	9. 15' 6"	13' 6"	9'

10. At $3\frac{1}{2}$ cents a foot, what will be the cost of picture molding for each of the above rooms?

11. At 25 cents a square foot, what will it cost to lay a hardwood floor in each of the above rooms?

12. A schoolroom is $30' \times 24' \times 12'$. Find the cost of putting a blackboard 4 feet wide on the long side at $22\frac{1}{2}$ cents per square foot.

13. At 30¢ a square yard, find the cost of plastering the walls and ceiling of a room 18 ft. long, 15 ft. wide, and 9 ft. high, making no allowance for openings.

14. Find the cost of plastering the room in problem 13, allowing 96 sq. ft. for openings.

Find the cost of plastering the walls and ceilings of the following rooms:

	LENGTH	WIDTH	HEIGHT	ALLOWANCE FOR OPENINGS	COST PER Sq. Yd.
15.	15'	12'	9'	$\frac{1}{2}$ total area	28¢
16.	21'	18'	10'	$\frac{1}{2}$ total area	25¢
17.	24'	18'	10'	20 sq. yd.	30¢
18.	27'	21'	12'	24 sq. yd.	24¢
19.	12'	10'	$8\frac{1}{2}'$	none	28¢

20. At 40 cents per square yard, what is the cost of plastering a room $15' \times 12' \times 8'$, allowing for 2 openings $6' \times 3'$, and 2 openings $8' \times 3\frac{1}{2}'$? Deduct one half the area of openings.

21. A room is $18' 9''$ long, $13' 6''$ wide, and 10' high. There are 2 openings $7' \times 3\frac{1}{2}'$, and 3 openings $6' \times 3'$. Find the area the plasterer reckons.

22. Make out the bill to the city for plastering the schoolroom at the local rates.

CARPETING

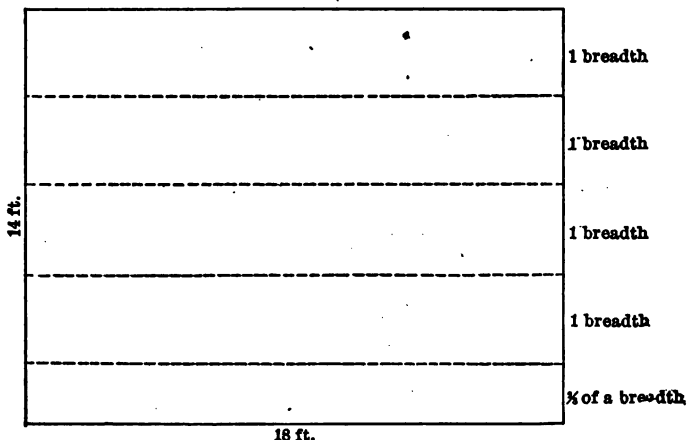
Carpeting is of varying widths, but is sold by the linear yard. In buying, the width must always be kept in mind. The more common widths are: ingrains 1 yard, and others $\frac{3}{4}$ of a yard.

The breadths or strips are usually laid lengthwise of the room. In the following problems follow this custom unless otherwise directed.

Since the dealer never cuts or splits a breadth, sometimes more carpeting must be purchased than is absolutely necessary to cover the floor. There is also frequently some waste in matching for which the purchaser has to pay.

Oilcloth, linoleum, etc., are sold by the square foot or the square yard.

1. How much carpeting is required for a room 18 ft. long and 14 ft. wide?



Since the carpet is laid lengthwise of the room, as many breadths or strips must be bought as the width of the carpet (3 feet) is contained times in the width of the room, 14 feet. $14 \div 3 = 4\frac{2}{3}$. Since the dealer never sells part of a breadth, 5 breadths must be purchased. Each strip runs the length of the room, 18 feet. $5 \text{ strips} = 90 \text{ feet}$ $90 \text{ feet} = 30 \text{ yards}$.

2. How many yards of carpeting must be bought for a room 16 ft. long and 13 ft. wide?

3. If an allowance of one foot on each strip except the first is made for matching, how many yards of carpeting will be required for a room 24 ft. long and 18 ft. wide?

4. About a room $18\frac{1}{2}$ ft. by $16\frac{1}{2}$ ft. is a hardwood border 1 ft. 6 in. wide. What are the dimensions of a rug just large enough to cover the rest of the floor?

5. I wish to carpet a room 21 ft. by 17 ft. in the most economical way. Which way ought the strips to run?

6. Make out the bill for carpeting a room 16 ft. by 15 ft. with Brussels carpet at \$1.10 per yard.

7. At \$1.50 per yard, what will it cost to carpet a room 19 ft. by 16 ft., if a total of $1\frac{1}{2}$ yards is wasted in matching?

8. In a certain room the carpet is to be laid crosswise. The room is $5\frac{3}{4}$ yd. long and $4\frac{3}{4}$ yd. wide. How much carpeting will be required?

9. How many yards of straw matting 1 yd. wide must be bought for a room 17 ft. 6 in. long and 11 ft. 10 in. wide?

10. At \$1.35 a square yard, what is the cost of a linoleum for a kitchen $13\frac{1}{2}$ ft. by 8 ft.?

Find the cost of carpeting the following rooms:

	DIMENSIONS OF ROOMS		WIDTH OF CARPET	PRICE PER YARD
	Length	Width		
11.	17 ft.	14 ft.	1 yd.	\$0.95
12.	18 ft.	15 ft.	$\frac{3}{4}$ yd.	\$1.45
13.	$16\frac{3}{4}$ ft.	$14\frac{1}{2}$ ft.	1 yd.	\$1.10
14.	19 ft.	$17\frac{1}{2}$ ft.	$\frac{3}{4}$ yd.	\$1.62 $\frac{1}{2}$

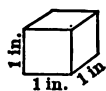
CUBIC OR VOLUME MEASURE

1. Write the table of cubic measure.

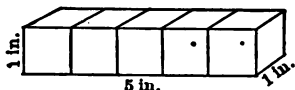
A load of earth, sand, etc., is a cubic yard.

The volume of a solid is the number of cubic units it contains.

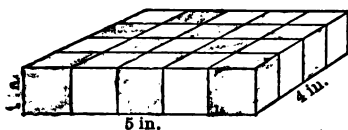
2. What is the volume of a solid 5 in. long, 4 in. wide, and 3 in. high?



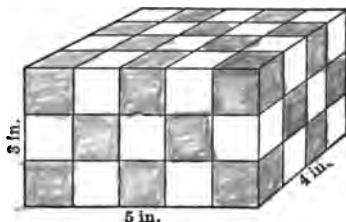
Unit of measurement



1 row of cubic units



1 layer of cubic units



The unit of measurement is 1 cubic inch. How many of these cubic units in 1 row? In 1 layer? In all the layers?

Steps taken:

First. Determine the unit of measurement.

Second. Find the number of cubic units in 1 row.

Third. Multiply the number of cubic units in 1 row by the number of rows.

Fourth. Multiply the number of cubic units in 1 layer by the number of layers.

In finding volumes the three dimensions must be expressed in the *same* unit of measurement (inches, feet, yards, etc.).

1. How many dimensions has a cube? How do they compare?

2. How many faces has a cube? What is their shape? How do they compare in size?

3. What is the length in feet of a 12-inch cube? The area of one of its faces in square feet? Of all its faces? Its volume in cubic feet?

4. Make and fill out a table like the following:

CUBES	LENGTH IN FEET	AREA OF FACES IN SQUARE FEET	VOLUME IN CUBIC FEET
12-inch 24-inch 36-inch	1 foot	6 square feet	1 cubic foot

Continue with 48-inch, 60-inch, 72-inch, 84-inch, 96-inch, 108-inch, 120-inch, 132-inch, 144-inch cubes.

Find the volumes of these rectangular prisms:

LENGTH	WIDTH	HEIGHT	LENGTH	WIDTH	HEIGHT
5. 6 ft.	5 ft.	7 ft.	6. 15 in.	12 in.	8 in.
7. 2 ft.	15 in.	9 in.	8. 4 ft.	1 yd.	$1\frac{1}{2}$ ft.
9. $1\frac{1}{2}$ yd.	$1\frac{1}{2}$ ft.	18 in.	10. 2 yd.	$2\frac{1}{4}$ ft.	18 in.
11. 27 in.	$1\frac{1}{2}$ ft.	15 in.	12. $1\frac{1}{4}$ yd.	$1\frac{1}{2}$ ft.	$2\frac{1}{2}$ ft.
13. 2.5 ft.	2.5 ft.	2.5 ft.	14. 3.5 ft.	2.25 ft.	2 ft.

15. What is the volume of a toy building block 2 in. by 2 in. by 2 in.? What is the capacity of a box that will exactly hold 12 of them? How many can be placed in a box 6 in. by 6 in. by 6 in.?

16. Which is larger, a 4-foot cube or 4 cubic feet? How much?

17. ~~X~~ What is the volume of a crate that will hold 24 boxes of butter each 1 ft. long, 4 in. wide, and 4 in. high?

18. ~~X~~ How many cubic feet in a stone step 4 ft. long, 15 in. wide, and 8 in. high?

19. ~~X~~ A camphor chest 4 ft. long and 3 ft. wide stands 2 ft. 6 in. high. Find its volume.

20. ~~X~~ A block of ice cream 1 ft. long, 4 in. wide, and 3 in. thick is served to 12 persons. What are the dimensions of each slice?

21. ~~X~~ A man buys 14 bales of hay, each 4 ft. long, $2\frac{1}{2}$ ft. wide, and 2 ft. thick. How much space will they occupy in his barn? What is their value at \$24 a ton, if their average weight is 150 pounds?

22. A stone pillar is $2\frac{1}{2}$ ft. square and $8\frac{1}{2}$ ft. high. What is its volume?

23. What is the capacity of a tank whose width is 3 ft., whose height is $\frac{1}{2}$ of its width, and whose length is twice its width?

24. Draw a diagram of the faces of a 4-inch cube, on a scale of $\frac{1}{2}$ " to 1".

25. Draw a diagram of the faces of a rectangular prism 4 ft. \times 3 ft. \times 2 ft. Scale 1" = 1'.

26. Find the surface area of a block of wood 3 inches square and 4 inches high.

27. How many square feet of copper will be required to line the bottom and sides of a tank 4 ft. long, 3 ft. wide, and 2 ft. deep?

28. At 6 cents a square foot, how much will it cost to line with zinc a tank 3 ft. long, $2\frac{1}{2}$ ft. wide, and 2 ft. deep?

29. At 75 cents a cubic yard, what is the cost of digging a cellar 24 ft. by 16 ft. by 7 ft. ?

30. How many loads of earth must be carted to fill a ditch 48 ft. long, 4 ft. deep, and of an average width of 9 ft. ?

WOOD MEASURE

1. A pile of wood 1 ft. by 4 ft. by 4 ft. is a cord foot. How many cubic feet in a cord foot ?

2. A pile of wood 8 ft. by 4 ft. by 4 ft. is a cord. How many cubic feet in a cord ? How many cord feet in a cord ?

3. Write the table of wood measure.

Wood, bark, etc., are generally sold by the cord.

4. How many cords of wood in a pile 20 ft. long, 4 ft. wide, and 6 ft. high ?

5. A pile of wood contains 1728 cubic feet. How many cords ?

6. A farmer has a wagon 12 ft. long and 4 ft. wide. How high must he pile the wood in loading a cord ?

7. At \$ 7.50 a cord, what is the value of a pile of 4-foot wood, 18 ft. long and 8 ft. high ?

Find the number of cords of 4-foot wood in the following lots :

LENGTH	HEIGHT	LENGTH	HEIGHT
8. 15 ft.	6 ft.	9. 18 ft.	4 ft.
10. 22 ft.	5 ft.	11. 16 ft.	$3\frac{1}{2}$ ft.
12. 24 ft.	$6\frac{1}{2}$ ft.	13. 20 ft.	$4\frac{1}{2}$ ft.
14. 12 ft. 6 in.	8 ft.	15. 16 ft.	$6\frac{1}{2}$ ft.

16. A railroad car 30 ft. long and 8 ft. wide is loaded 6 ft. high with wood. What is the value of the wood at \$8.75 per cord ?

MASONRY

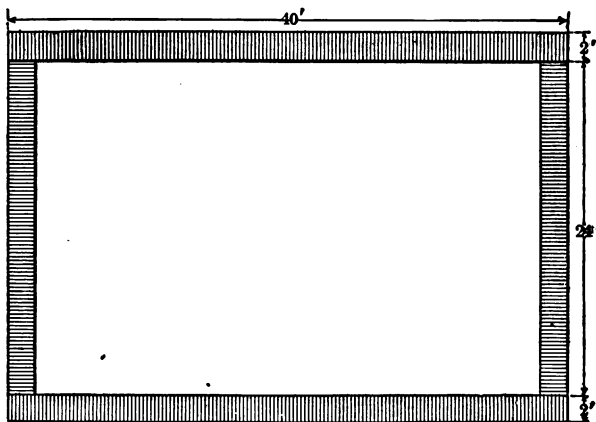
Masonry and bricklaying are usually measured by the cubic foot.

In estimating the number of cubic feet in the walls of buildings, the outside dimensions are taken. This counts the corners twice, but the extra labor required to build the corners offsets their double counting.

In estimating the material required, the corners are counted once.

Common bricks are $8'' \times 4'' \times 2''$, and, allowing for space occupied by mortar, 22 of them will lay a cubic foot.

1. The outside dimensions of a foundation wall are 40 ft. by 28 ft. The cellar is 9 ft. deep and the walls are 2 ft. thick. Find the number of cubic feet of masonry; the number of cubic feet of material required.



HINT. Reckoning the outside dimensions, the cellar walls are equivalent to a single wall $40' + 28' + 40' + 28'$, or 136', in length.

Reckoning exactly, the cellar walls are equivalent to a single wall $40' + 24' + 40' + 24'$, or 128', in length.

2. How many cubic feet of masonry in a wall 60 ft. long, 5 ft. high, and $1\frac{1}{2}$ ft. thick? How many bricks are required to build this wall?

3. How many cubic feet of stone will be required to build a foundation for a storehouse $100' \times 60'$, if the walls are 4' thick and 10' high?

4. At \$0.90 per cubic foot, what will be the expense of building a brick wall $2\frac{1}{2}$ ft. high and $1\frac{1}{2}$ ft. thick on the two street sides of a corner lot 120 ft. by 80 ft.?

5. At \$2.75 per cubic yard, what will it cost to build the foundation of a house 36 ft. by 24 ft., outside measurements, if the cellar is to be 9 ft. high and the wall $1\frac{1}{2}$ ft. thick?

6. When bricks are \$8 $\frac{1}{2}$ per M, what will be the cost of the bricks necessary to build a partition wall 48 ft. long, 27 ft. high, and 8 in. thick?

7. The north side of a greenhouse is a brick wall 24 ft. long, 12 ft. high, and 8 in. thick. Find the surface area of the side; the number of cubic yards of masonry in the wall.

BOARD MEASURE

Wood used in building is called *lumber*, and is sold by the *board foot* (bd. ft.).

A board foot is a board a foot square, or its equivalent, and one inch or less in thickness.

In measuring lumber the thickness is regarded only when it exceeds one inch.

A board 12 feet long, 1 foot wide, and 1 inch thick contains 16 board feet. If less than an inch thick, it is still reckoned as 16 board feet. If $1\frac{1}{2}$ inches thick, it contains $1\frac{1}{2}$ times 16 board feet, or 24 board feet.

The price of lumber is usually given for a thousand feet, and the thousand feet indicated by the letter M.

The number of board feet in a piece of lumber is found by multiplying its length in feet by its width in feet by its thickness in inches.

In solving problems, reckon to the nearest board foot.

1. How many board feet in a board 18 ft. long, 1 ft. wide, and $\frac{7}{8}$ of an inch thick?

2. A floor board is 12 ft. long, 8 in. wide, and $\frac{7}{8}$ of an inch thick. How many board feet does it contain?

3. At 6 cents a board foot, what must be paid for 10 boards, each 12 ft. by 6 in. by $\frac{7}{8}$ of an inch?

4. How many board feet in 12 boards 16 ft. by $1\frac{1}{2}$ ft.? If the thickness is not mentioned, it is always understood to be 1 inch or less.

5. Allowing $\frac{1}{4}$ for waste, how many feet of flooring boards must be bought for a room 12 ft. by 10 ft.?

6. At \$30 per M, what is the cost of 500 ft. of pine sheathing? 250 ft.? 200 ft.? 100 ft.? 800 ft.?

7. What is the rate per M, when hemlock boards are sold at 2 cents per board foot? $2\frac{1}{2}$ cents? $3\frac{1}{4}$ cents?

8. What is the rate per board foot when lumber is quoted at \$30 per M? At \$35? At \$42?

9. Find the cost of 380 ft. of lumber at \$45 per M.

10. What is the rate per M, when \$11 is paid for 275 ft. of spruce boards?

At \$45 per M, what is the cost of 24 boards each 16 ft. long, 1 ft. wide, and $1\frac{1}{4}$ in. thick?

$$\begin{aligned} (1) \quad 24 \times 16 \times 1 \times \frac{1}{4} &= 480, \text{ the number of board feet} \\ 480 \text{ bd. ft.} &= .48 \text{ of a thousand feet} \\ .48 \times \$45 &= \$21.60 \end{aligned}$$

- (2) $24 \times 16 \times 1 \times \frac{1}{4} = 480$, the number of board feet
 $\$45 \div 1000 = \0.045 , the cost of a board foot
 $480 \times \$0.045 = \21.60

11. What is the cost of 20 planks $16' \times 9'' \times 2\frac{1}{2}''$ at \$60 per M?

12. At \$36 per M, what is the value of 60 boards $10' \times 10'' \times \frac{7}{8}''$?

13. 24 sticks of timber 12 ft. long and 8 in. square were bought at \$32 per M. What was the cost?

14. What is the cost of 30 joists, $3'' \times 4''$, 16 ft. long at \$28 per M?

15. How many feet, board measure, in a chopping block 2 ft. 6 in. high and covering a space of 4 square feet on the ground? Find its value at \$24 per M.

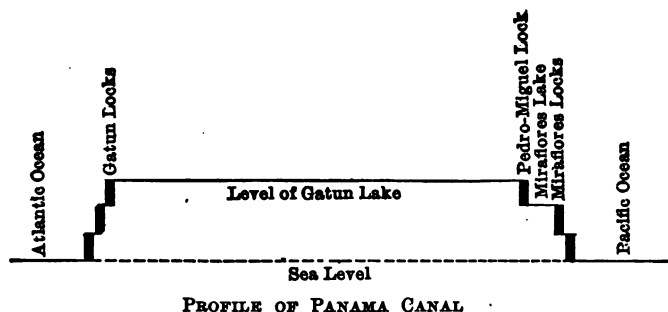
16. At \$30 per M, how much will it cost to build on the baseball grounds a catcher's fence 12 ft. long and 6 ft. high, supported by four $3'' \times 4''$ joists set 2 ft. in the ground?

PROBLEMS ABOUT THE PANAMA CANAL

1. The Panama Canal Zone is a strip of land 10 miles wide across the Isthmus of Panama, $47\frac{1}{2}$ miles. What is the area of the zone? (Keep answers.)

2. It was ceded to the United States in February, 1904. How long ago? (Give answer in years and months.)

3. The total length of the canal is about 50 miles, 15 of which are at sea level. What part of the canal is above sea level?



4. Vessels entering on the Atlantic side will be raised to the level of Gatun lake by three locks, each having a lift of 28 feet 4 inches. How many feet above sea level is Gatun lake?

5. Gatun lake is about 32 miles long. This is what part of the whole canal? Of the canal above sea level?

6. After crossing Gatun lake, vessels will be lowered by the Pedro-Miguel lock $\frac{6}{17}$ of the height above sea level to Miraflores lake. How many feet above sea level is Miraflores lake?

7. The distance across Miraflores lake to Miraflores locks is about $1\frac{1}{2}$ miles. How many feet?

8. At Miraflores vessels will be lowered to sea level by two locks equal in height. How many feet by each lock?

9. Each of the six locks is 1000 feet long and 110 feet wide, inside dimensions. The length is how many times the width? Each lock is what part of a mile in length? What are the dimensions of each lock in rods? The area in acres?

10. The crest of the great dam at Gatun is 10 yards above the height of Gatun lake. How many feet above sea level?

11. The dam at Gatun is 9040 feet long and 100 feet wide at its crest. What is the ratio of the length to the width? The length in miles? The width in rods? The area in acres?

12. The ocean steamship *Mauretania* is 790 feet in length and 88 feet in width. How many feet less than the length and the width of one of the locks?

13. The distance from New York to San Francisco by way of Straits of Magellan is 13,714 miles; by way of the canal the distance will be 5299 miles. How many miles will be saved by the Panama route?

14. The commercial route from Liverpool to San Francisco is 14,084 miles; by the canal it will be 8038 miles. How many miles shorter by the canal?

15. In going from New Orleans to Adelaide, Australia, a vessel sails 13,543 miles; 3209 miles will be saved by the canal. How far from New Orleans to Adelaide by way of the canal?

16. Calling the distance from Liverpool to San Francisco by way of Straits of Magellan 14,000 miles, and by way of the canal 8000 miles, and the average speed of a steamship 20 miles an hour, find:

(a) The number of days required to make the trip by way of Straits of Magellan.

(b) The number of days required to make the trip by way of the canal.

(c) The number of days saved by the canal route. Find this in two ways.

17. The estimated cost of the canal is \$375,000,000. What is the average cost per mile?

18. The Suez canal is a sea-level canal 90 miles long and cost \$100,000,000. Find the average cost per mile.

19. The cost of the Panama canal is how much more per mile than the cost of the Suez canal per mile?

AVOIRDUPOIS WEIGHT

1. How many ounces in 1 pound?

2. How many pounds in an ordinary ton?

3. Some articles are sold by the hundredweight (cwt.). How many hundredweight make 1 ton?

4. A long ton contains 240 pounds more than the ordinary ton. How many pounds make a long ton?

In problem work always use the ordinary ton unless otherwise directed.

5. Write the table of Avoirdupois weight.

6. What is the ratio of a pound to a hundredweight? A hundredweight to a ton? A hundredweight to a long ton? An ordinary ton to a long ton?

7. At 32 cents a pound, how much will 1 pound 14 ounces of butter cost?

8. When 50 pounds of ice are sold for 15 cents, what is the rate per ton?

9. How many pound packages can be put up from $2\frac{1}{2}$ hundredweight of cereal?

10. When a bushel of oats (32 pounds) costs 50 cents, how much will a ton cost?

11. An ice dealer pays 6 cents per hundredweight for his ice. At what rate per hundredweight must he retail it to make \$1.50 per ton if the expense of handling is \$1.30 per ton?

12. Find the cost of 3800 pounds of coal at \$6.50 per ton.

13. Find the cost of 2800 pounds of fertilizer at \$36 per ton, and 1600 pounds at \$37.50 per ton.

14. A dealer in farm supplies bought 75 long tons of fertilizer and sold it by the ordinary ton. How many tons did he sell?

15. A shipment of wheat weighed 24,000 pounds. How many ordinary tons? How many long tons?

16. Mr. Evans sold the following quantities of shorts: $\frac{7}{8}$ of a ton, 25 hundredweight, $1\frac{3}{4}$ tons, 1500 pounds, 1200 pounds. How many tons?

17. Out of a consignment of 2 tons of potatoes, 32 hundredweight were sold. What part of a ton was left?

18. Find the cost of 2780 pounds of oat straw at 85 cents per hundredweight.

19. Mr. Wheeler paid \$35 for $2\frac{1}{2}$ tons of shorts. What was the price per hundredweight?

20. Rye meal is 2.25 cents per pound. Find the cost of 3.6 hundredweight.

21. \$36.45 was paid for oats at 45 cents a bushel. Find the weight, reckoning 32 pounds to a bushel.

22. Mr. Norcross sold 792 pounds of barley, 48 pounds to the bushel, at 90 cents a bushel. Find how much he received for it.

23. The equipment of a 25-acre hay farm in South Carolina, as given in a report by the Department of Agriculture, was: 1 Georgia plow stock with attachments, \$5; 1 smoothing harrow, \$10; 1 weeder, \$7; 1 curved-tooth and slicing harrow, \$10; 1 mower, \$35; 1 hayrake, \$15; 1 wagon, \$30; 1 hay press, \$90; 1 wooden roller, \$7.50. Total cost?

24. The expenses and receipts of this farm for one year:

EXPENSES

One man at \$35 per month	\$
One horse, cost of keeping at \$8.50 per month	
Interest on 25 acres of land, valued at \$100 per acre, at 8 %	
Depreciation on \$209.50 worth of machinery, at 20 %	
Taxes, \$38.00	
Total expense	\$

RECEIPTS

7 acres crimson clover hay, 3500 pounds per acre, at \$1.25 per hundredweight	\$
18 acres oat hay, 3000 pounds per acre, at \$25 per ton	
22 acres cowpea hay, 1½ tons per acre, at \$1.25 per hundredweight	
3 acres corn, 66½ bushels per acre, at 75 cents per bushel	
3 acres corn stover, 4000 pounds per acre, at \$15 per ton	
Total income	\$

Find (1) the total expense; (2) the total income; (3) the net income.

LIQUID MEASURE

1. Repeat the table of liquid measure.
2. How many pints in 1 gallon? 1 gallon 1 quart? 1 gallon 1 quart 1 pint?

3. How many quarts in $6\frac{1}{2}$ gallons? How many pints?
4. How many gallons and quarts of vinegar in a 5-gallon jug one half full?
5. How many half-pint bottles can be filled from $2\frac{1}{2}$ quarts of cream?
6. Four half-pint bottles of cream cost 1 dollar. The milkman allows 10 cents for each bottle returned. What is paid a quart for cream?
7. Mrs. Mason bought a gallon of maple sirup. She sold 2 quarts 1 pint to a neighbor. What part of the gallon did she sell?
8. If Mrs. Mason sold the sirup at cost, \$1.20 per gallon, how much did she receive for what she sold?

CONVENIENT EQUIVALENTS

1 gallon = 231 cubic inches

1 cubic foot = $7\frac{1}{2}$ gallons (nearly)

divide multiply

9. What is the capacity in gallons of a tank 24 inches long, 11 inches wide, and 14 inches deep?

$$\frac{24 \times 11 \times 14}{231}$$

$24 \times 11 \times 14$ represents what?

$$\frac{24 \times 11 \times 14}{231} \text{ represents what?}$$

Find the capacity in gallons of tanks of these dimensions:

	LENGTH	WIDTH	DEPTH		LENGTH	WIDTH	DEPTH
10.	22"	21"	9"	11.	22"	14"	6"
12.	30"	28"	22"	13.	44"	28"	27"

221

	LENGTH	WIDTH	DEPTH		LENGTH	WIDTH	DEPTH
✓ 14.	2'9"	1'9"	1'3"	15.	2'9"	2'3"	2'6"
16.	4'	3'	2'	✓ 17.	5'	3'	4'
18.	4'	31'	51'	19.	32'	31'	42'

$$\begin{array}{r} 49 \\ 1 \overline{) 49} \\ 49 \\ \hline 0 \end{array}$$

20. A tin dish 11 inches long, 7 inches wide, and 3 inches deep holds how many gallons? How many if twice as long? If twice as long and twice as wide? If twice as long, twice as wide, and twice as deep?
21. A tank 28 inches long, 22 inches wide, and 18 inches deep is full of water. How many gallons?
22. How many gallon jugs can be filled from a tank 7 feet long, 3 feet wide, and $5\frac{1}{2}$ feet deep?
23. A hot-water tank on the back of a stove is 2 feet 4 inches long, 1 foot 2 inches wide, and 11 inches deep. How many gallons does it hold?
24. A copper boiler covers 168 square inches on the top of a stove. It stands 22 inches high. What is its capacity in gallons?
25. How many times will you have to fill and empty a gallon dipper with water to fill a tank 1 foot 3 inches long, 1 foot 2 inches wide, and 11 inches deep?
26. A watering trough is 2 feet 6 inches long, 2 feet 4 inches wide, and 1 foot 10 inches deep. How many gallons of water will it hold?
27. The capacity of an oil tank is 252 cubic feet. What is its capacity in barrels of 42 gallons each?

234
—
924

DRY MEASURE

Oral

1. Repeat the table of dry measure.
2. A quart is what part of a peck? A peck of a bushel? A quart of a bushel?

$$\begin{array}{r} 539 \\ \times 5 \\ \hline 2695 \end{array}$$

3. Express as pecks: 4 bu. $2\frac{3}{4}$ bu. 40 qt. 37 qt.
4. Express as bushels: 48 pk. 27 pk. 64 qt. 70 qt.
5. Express as quarts: 24 pk. 27 pk. 2 bu. 1 bu., 1 pk.
6. A quart of barley weighs $1\frac{1}{2}$ pounds. What is the weight of a peck? A bushel?
7. A bushel of wheat weighs 60 pounds. A peck weighs — pounds. A quart weighs — pound.

CONVENIENT EQUIVALENTS

1 bushel = 2150.42 cubic inches = $1\frac{1}{4}$ cubic feet (nearly).

Small fruits, beans, oats, wheat, shelled corn, etc., are measured by the stricken bushel, that is, a bushel measure even full, $1\frac{1}{4}$ cubic feet (nearly).

Larger fruits, potatoes, apples, corn in the ear, etc., are measured by the heaped bushel, $1\frac{1}{4}$ cubic feet (nearly).

WRITTEN PROBLEMS

1. What is the capacity in bushels of a bin 16 feet long, 7 feet wide, and 5 feet deep?

$$(16 \times 7 \times 5) \div 1\frac{1}{4} \quad 16 \times 7 \times 5 \text{ represents what?}$$

$$16 \times 7 \times 5 \times \frac{4}{5} = 448 \quad (16 \times 7 \times 5) \div 1\frac{1}{4} \text{ represents what?}$$

Find the capacity in bushels of bins of these dimensions:

LENGTH	WIDTH	DEPTH	LENGTH	WIDTH	DEPTH
2. 7'	5'	3'	3. 10'	8'	5'
4. 15'	5'	4'	5. 20'	6'	8'
6. 5'	4' 8"	2' 8"	7. 4'	3 $\frac{1}{8}$ '	3'
8. 6' 8"	3' 9"	5'	9. 16'	4.5'	2.25'

10. A box $2\frac{1}{2}$ feet by $2\frac{1}{2}$ feet by $2\frac{1}{2}$ feet is full of meal. How many bushels?

11. A farmer's corn crib is 8 feet by $2\frac{1}{2}$ feet by 6 feet. How many bushels will it hold?

12. At 32 pounds to a bushel, what is the weight of oats in a box 5 feet by 2 feet by 3 feet?

13. A corn crib, 12 feet by 4 feet by 5 feet, is filled with corn in the ear. It takes 2 bushels of corn in the ear to make 1 bushel of shelled corn. The corn in the crib will make how many bushels of shelled corn?

14. Reckoning 56 pounds to a bushel, what is the weight of the corn in a box $2\frac{1}{2}$ feet long, 2 feet wide, and $1\frac{1}{2}$ feet deep?

15. At 98 cents a bushel, what ought Mr. Akers to receive for the wheat that just fills a bin 8 feet by 4 feet by $2\frac{1}{2}$ feet?

16. Mr. Edwards has in his cellar a bin 15 feet by 10 feet by 6 feet, filled with apples. How many bushels ($1\frac{1}{2}$ cubic feet to a bushel)?

SCHOOL KITCHEN PROBLEMS

1. Find the total cost of the following cooking outfit for a country school: 1 blue-flame 3-burner, kerosene stove, \$6.25; 2 dish pans @ 25¢; 2 salt and 2 pepper castors @ 10¢; 10 rolling pins @ 15¢; 10 teacups and 10 saucers @ 5¢; 10 plates @ 8¢; 3 agate saucepans @ 35¢; 10 wooden spoons @ 10¢; 1 dozen knives, \$1.50; 1 dozen forks, \$1.50; 1 dozen spoons @ 10¢; 10 vegetable knives @ 15¢; 5 strainers @ 10¢; 10 beaters @ 15¢; 10 measuring cups @ 8¢; 10 tin plates @ 5¢;

13 bowls @ 5¢; 10 custard cups @ 8¢; 6 bread tins @ 10¢; 1 biscuit tin 10¢; 1 potato masher 10¢; 1 flour sifter 15¢.

MENU OF DINNER SERVED TO SIX PERSONS BY THE GIRLS IN THE SCHOOL IN PROBLEM 1

Menu		
SOUP		
TOMATO BISQUE		CROUTONS
RELISHES		
CELERY		PICKLES
ROAST		
SIRLOIN OF BEEF		
VEGETABLES		
RICED POTATOES		PICKLED BEETS
SALAD		
WALDORF		WAFERS
DESSERT		
CUSTARD, WITH CARAMEL SAUCE		
GRAPES		MILK

2. Using the tables below, find the cost of each course; of the entire dinner; for each person.

COST OF MATERIAL

Apples, 15¢ per doz.
 Beef, 25¢ per lb.
 Beets, 6¢ per lb.
 Bread, 5¢ per loaf
 Butter, 32¢ per lb.
 Celery, 15¢ per bunch
 Eggs, 35¢ per doz.
 Grapes, 2 lb. for 25¢
 Lettuce, 7¢ per head

Mayonnaise dressing, 30¢
 Milk, 7¢ per qt.
 Pickles, 10¢ per qt.
 Potatoes, 24¢ per pk.
 Sugar, 6¢ per lb.
 Tomatoes, 16¢ per can
 Wafers, 15¢ per box
 Flour and seasonings for Bisque,
 8¢

Quantities used:

- (1) *Soup*: $\frac{1}{2}$ can tomatoes, 1 qt. milk, 8 tbsp. flour, 3 tbsp. butter ($1\frac{1}{2}$ oz.), seasonings (onion, salt, cloves, pepper, celery, parsley, bay-leaf, sugar, soda). One loaf bread for croutons and dinner.

Relishes: 1 bunch celery, 1 pt. pickles.

- (2) *Roast*: 5 lb. beef.

Vegetables: 1 qt. potatoes, $\frac{1}{2}$ cup butter (2 oz.), 1 lb. beets.

- (3) *Salad*: 4 apples, $\frac{1}{2}$ bunch celery, 1 head lettuce, Mayonnaise dressing. Wafers, 1 box.

- (4) *Dessert*: Custard: 6 eggs, 1 qt. milk, 8 tbsp. sugar (4 oz.).

Caramel sauce: $1\frac{1}{2}$ cups sugar ($\frac{1}{2}$ lb.).

Grapes: 2 lb. Milk: 2 qt.

3. Find the cost of a similar dinner served to 20 persons.

TIME MEASURE

The unit of time measure is the day, or 24 hours, the time required for a complete rotation of the earth on its axis.

TABLE OF TIME MEASURE

60 seconds (sec.)	= 1 minute (min.)
60 minutes	= 1 hour (hr.)
24 hours	= 1 day (da.)
7 days	= 1 week (wk.)
30 days	= 1 commercial month
28, 29, 30, or 31 days	= 1 calendar month
12 calendar months	= 1 year (yr.)
365 days	= 1 year
366 days	= 1 leap year
10 years	= 1 decade
100 years	= 1 century

1. The minute hand of a clock moves how many times as fast as the hour hand?

2. A clock that ticks seconds will tick how many times in an hour? In a day?

3. A clock striking hours will strike how many times in a day?

4. The speedometer of an automobile shows a rate of 24 miles per hour. What is the rate per minute?

5. An automobile runs a mile in $2\frac{1}{2}$ minutes. What rate per hour does the speedometer show?

6. Two clocks show the same time at noon to-day. One runs perfectly, and the other gains $\frac{1}{4}$ of a minute every hour. What time will the latter show at noon to-morrow?

7. Ashton's watch gains 10 seconds an hour. If it is exactly right at 9 o'clock in the morning on Tuesday, what time on Thursday afternoon will it show when it is 3 o'clock by correct time?

8. Louise left home at 2:47 o'clock and arrived at her uncle's at 5:28. How many hours and minutes was she on the way?

9. It took Harry 3 hours 42 minutes to return from the summer camp. He left camp at 10:53 o'clock in the forenoon. At what time did he reach home?

10. At a rate of 18 miles an hour, it takes a touring car 1 hour and 5 minutes to go from A to B, 15 minutes being spent in replacing a broken tire. How many miles apart are the two places?

11. Years divisible by 4 are leap years, except centennial years not divisible by 400. Tell which of these years are leap years: 1912; 1918; 1920; 1900; 2000.

DRILL EXERCISES

Change to the next higher denomination;

- | | |
|--------------------------|---------------------|
| ✕ 1. 400 min. | 2. 27 pt. |
| ✕ 3. 120 oz. | 4. 602 in. |
| ✕ 5. 3456 sq. in. | 6. 228 sec. |
| ✕ 7. 24,600 lb. | 8. 16,400 qt. (dry) |
| ✕ 9. 1452 doz. | 10. 1089 cu. ft. |
| ✕ 11. 640 cu. ft. (wood) | 12. 769 cd. ft. |
| ✕ 13. 1680 rd. | ✕ 14. 302 qt. |
| ✕ 15. 200 hr. | ✓ 16. 242 sq. ft. |
| ✕ 17. 378 ft. | ✕ 18. 5000 cu. in. |
| ✕ 19. 10,587 | 20. 692 yd. |
| ✕ 21. 302 qt. (liquid) | 22. 150 da. |
| ✕ 23. 1010 quires | 24. 7680 doz. |

Change to the next lower denomination :

- | | | |
|------------------------|---------------------------|----------------------------|
| 1. $\frac{7}{8}$ mi. | 2. $\frac{5}{8}$ bu. | 3. $\frac{3}{4}$ A. |
| 4. $\frac{1}{8}$ wk. | 5. $\frac{1}{8}$ ream | 6. $\frac{7}{16}$ cd. |
| 7. $\frac{1}{2}$ da. | 8. $\frac{1}{8}$ cu. yd. | 9. $\frac{1}{2}$ sq. yd |
| 10. $\$ \frac{2}{8}$ | 11. $\frac{2}{10}$ gal. | 12. $\frac{5}{16}$ T. |
| 13. $\frac{9}{11}$ yr. | 14. $\frac{5}{8}$ sq. ft. | 15. $\frac{7}{16}$ cu. ft. |
| 16. $\frac{1}{11}$ rd. | 17. $\frac{5}{16}$ hr. | 18. $\frac{7}{10}$ cwt. |

Find the value of :

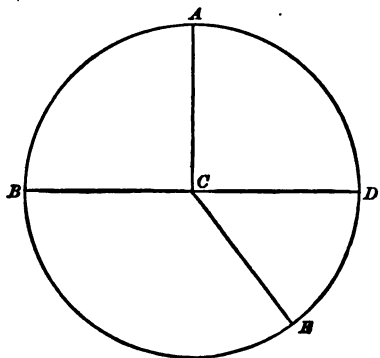
- | | | |
|--------------|-----------------|-----------------|
| 1. .27 mi. | 2. .625 bu. | 3. .325 A. |
| 4. .03 wk. | 5. .09 ream | 6. .33 cd. |
| 7. .905 da. | 8. .4 cu. yd. | 9. .6 sq. yd. |
| 10. \$0.675 | 11. .48 gal. | 12. .54 T. |
| 13. .095 yr. | 14. .22 sq. ft. | 15. .65 cu. ft. |
| 16. .015 rd. | 17. .35 hr. | 18. .875 yd. |

Change:

- | | |
|-------------------------------------|--------------------------------|
| 1. 3 da. 12 hr. to min. | 2. 24 rd. 3 yd. to yd. |
| 3. $4\frac{1}{4}$ T. 15 lb. to lb. | 4. 3 cd. 56 cu. ft. to cu. ft. |
| 5. 24 rd. 12 ft. to ft. | 6. 72 bu. 3 qt. to qt. |
| 7. 7 pk. 3 qt. to qt. | 8. 11 gal. 2 qt. to qt. |
| 9. 15 A. 72 sq. rd. to sq. rd. | 10. 10 reams 7 qr. to qr. |
| 11. 3 mi. 100 rd. to ft. | 12. 5 yd. 2 ft. to ft. |
| 13. 3 bu. 3 pk. 3 qt. to qt. | 14. 3 A. 3 sq. rd. to sq. rd. |
| 15. 3 sq. rd. 30 sq. ft. to sq. ft. | 16. 4 mi. 6 ft. to in. |
| 17. 15 cd. to cu. ft. | 18. $1\frac{7}{12}$ da. to hr. |
| 19. $8\frac{3}{4}$ gal. to qt. | 20. $15\frac{3}{4}$ bu. to qt. |

CIRCLES

A *circle* is a surface bounded by a curved line every point of which is equally distant from a point within called the *center*. The boundary line is the *circumference*.



A *diameter* of a circle is a straight line running through the center and terminating at the circumference on either side. *BD* is a diameter of the circle above.

A *radius* is a straight line running from the center to the circumference. *CA*, *CD*, *CB*, are radii of the circle above.

Compare the radius and the diameter.

A portion of a circle inclosed by two radii and a part of the circumference is a *sector*. CDE is a sector of the circle on page 228.

Using a tape measure, find the circumference and the diameter of any circular object. Divide the length of the circumference by the length of the diameter, carrying out the division three decimal places. How many times is the diameter contained in the circumference?

By very accurate measurements it has been found that the circumference is 3.14159^+ , or 3.1416 times the diameter. Since 3.1416 equals $3\frac{1}{7}$, nearly, for approximate measurements the circumference may be regarded as $3\frac{1}{7}$ times the diameter.

FINDING THE CIRCUMFERENCE

Using $3\frac{1}{7}$ as the ratio of the circumference to the diameter, find the circumference of:

~~1.~~ A plate 7 inches in diameter.

~~2.~~ A carriage wheel 35 inches in diameter.

~~3.~~ A circular table whose diameter is 28 inches.

~~4.~~ A pencil whose diameter is $\frac{7}{8}$ of an inch.

~~5.~~ A circle drawn with a 21-inch radius.

~~6.~~ A circular garden plot whose radius is $4\frac{1}{2}$ feet.

~~7.~~ A 50-cent piece, diameter $1\frac{1}{4}$ inches.

~~8.~~ Tell how to find the approximate circumference of a circle when the diameter is given; when the radius is given.

FINDING THE DIAMETER AND THE RADIUS

Find the approximate diameter and radius of :

1. A bicycle wheel whose circumference is 88 inches.
2. A stove lid 22 inches in circumference.
3. A circular pond whose shore line is 242 rods.
4. A water main $3\frac{1}{2}$ feet in circumference.
5. A carriage wheel covering a distance of 198 inches in one revolution.
6. A magnifying glass the distance around whose rim is $2\frac{1}{2}$ inches.
7. Tell how to find the approximate diameter of a circle when the circumference is given ; how to find the radius when the circumference is given.

PROBLEMS

- In solving the following problems call the circumference 3.1416 times the diameter.
1. What is the circumference of a circle drawn with a 20-inch radius?
 2. The shore line of a circular pond is 7854 feet. How far is it across the pond in a straight line?
 3. The distance around an old oak tree is 94.248 inches. What is the distance through the tree?
 4. A circular flower bed has a radius of 8 feet. What is its circumference?
 5. The distance around a circular grass plot is 471.24 feet. What is its diameter?



1 c
13 k

~~6.~~ A circular race track is 2640 feet long. What length of radius was used to lay out the track?

~~7.~~ A baseball is 2.875 inches in diameter. What is its circumference?

~~8.~~ What is the circumference of the largest circle you can draw on a piece of paper 7 inches by 10 inches?

In solving the following problems call the circumference 31 times the diameter.

~~9.~~ A bicycle wheel is 28 inches in diameter. How many inches does it go in one revolution? How many feet in 1000 revolutions? How many miles?

~~10.~~ How many revolutions will be made by a bicycle wheel 28 inches in diameter in going 1 mile?

~~11.~~ A wagon wheel has a radius of 21 inches. How long a piece of iron must be used for the tire?

~~12.~~ What must be the diameter of a chimney hole to receive a stovepipe 21 inches in circumference?

~~13.~~ A man on the shore of a circular pond wishes to go to a point on the opposite side. The distance by boat is 35 rods. Being afraid to go by boat, he walks along the shore. How far does he walk? What part of a mile is it by boat? By walking?

Calling the ratio of the circumference to the diameter 3.1416, find the missing dimensions:

RADIUS

DIAMETER

CIRCUMFERENCE

~~14.~~ 4 feet

?

~~15.~~

?

20 feet

~~16.~~

?

17 rods



AREA OF CIRCLE

Draw a large circle and divide it into a large number of equal sectors. Cut

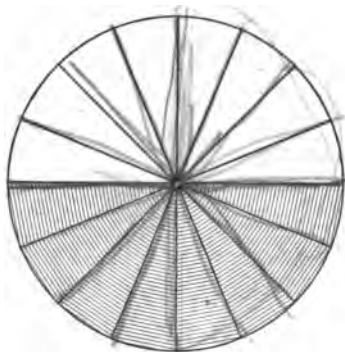


FIGURE 1

into semicircles. Cut each semicircle along the line dividing it into sectors. Arrange the parts of one semicircle as in the lower part of figure 2. Arrange the parts of the other semicircle as in the upper part of figure 2. The figure produced is practically a parallelogram whose base

is $\frac{1}{2}$ of the circumference of the circle and whose altitude is the radius of the circle.

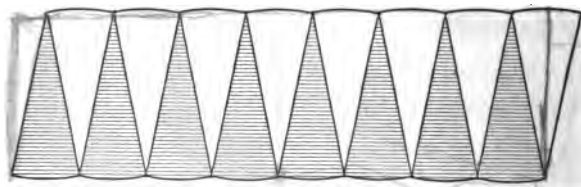


FIGURE 2

The area of a circle is equal to one half the product of its circumference and its radius.

Calling the circumference $3\frac{1}{2}$ times the diameter, find the area of:

- ① A plate 7 inches in diameter.
- ② A circular table 28 inches across.

3. A piano stool 14 inches in diameter.
4. A circular bed of pansies, if the bed is 35 inches in diameter.
5. A circle drawn with a $3\frac{1}{2}$ -foot radius.
6. A button $1\frac{1}{2}$ inches in diameter.
7. A medal whose circumference is 22 inches.
8. A circular window the distance around whose edge is 5 feet 6 inches.
9. A watch crystal $1\frac{1}{4}$ inches in diameter.
10. A 50-cent piece, diameter $1\frac{2}{10}$ inches.

Find the exact area of:

11. The base of a tin pail whose diameter is 8 inches.
12. The end of a log 15 inches in diameter.
13. The surface covered by the bottom of a pitcher 5 inches across.
14. A clock dial whose radius is 4 inches.
15. The largest circle that can be drawn on a piece of paper 7.5 inches square.

PROBLEMS

1. Find the area over which a cow can feed if tied to a stake by a rope 28 feet long. (Use $3\frac{1}{2}$.)
2. The curbing about a circular pond is 78.54 feet. Find the area covered by the pond. (Use 3.1416.)
3. The bottom of a barrel is 1 foot 9 inches in diameter. What area does it cover on the floor? (Use $3\frac{1}{2}$.)

4. What is the area covered by the base of a circular kettle 15 inches in diameter? (Use 3.1416.)

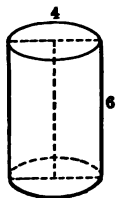
5. At $1\frac{1}{2}$ cents a foot, how much will it cost to fence a circular bed of tulips if the distance across the bed is 56 inches? (Use $3\frac{1}{2}$.)

6. A farmer has a well $3\frac{1}{2}$ feet in diameter. What is the area of the opening? (Use $3\frac{1}{2}$.)

7. Find the approximate area of the base of a circular chimney 35 feet in diameter; the exact area.

CYLINDER: SURFACE, VOLUME

Of what shape are the ends or bases of this solid? How do they compare in size? If the bases are equal and parallel, what is true of their diameters? What is true of the diameter of the whole solid?

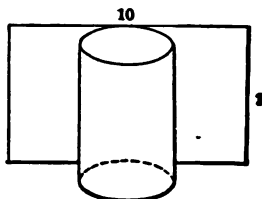


A solid of uniform diameter whose bases are equal and parallel circles is a *cylinder*.

The *altitude* of a cylinder is the perpendicular distance between its bases.

The lateral or curved surface of a cylinder is the *convex* surface.

Exactly fit a piece of paper around a cylinder. What form has it when unrolled? How does the length of the rectangle compare with the circumference of the base? How does the width of the rectangle compare with the altitude of the cylinder? How can the convex surface of a cylinder be found?



The convex surface of a cylinder is equal to the product of its circumference and its altitude.

The entire surface of a cylinder is equal to the sum of the convex surface and the areas of the bases.

1. What is the convex surface of a cylinder whose circumference is 14 in. and whose altitude is 3 ft.?

Find the convex surface of these cylinders:

DIAMETER	HEIGHT	DIAMETER	HEIGHT
2. 10 in.	15 in.	3. 15 in.	18 in.
4. 25 in.	35 in.	5. 12 in.	45 in.
6. 4 ft.	12 ft.	7. 6 ft.	16 ft.

8. Find the entire surface of the above cylinders.

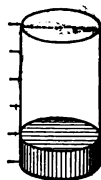
9. What is the convex surface of a stovepipe 7 in. in diameter and 3 ft. long?

10. A tin dish is 5 in. in diameter and 10 in. high. What is its entire outside surface?

11. What is the entire outside surface of a log 25 in. in diameter and 14 ft. long?

12. At 12¢ a square yard, how much will it cost to paint the convex surface of a silo 15 ft. in diameter and 24 ft. high?

If the base of this cylinder covers 2 sq. in., how many cubic inches are represented by a layer 1 in. high? How many cubic inches in the whole cylinder?



Tell how to find the volume of a cylinder.

The volume of a cylinder is found by multiplying the area of its base by its altitude.

Find the volumes of these cylinders:

	DIAMETER	HEIGHT
1.	21 in.	49 in.

2.	3½ ft.	7 ft.
----	--------	-------

3.	8 ft.	15 ft.
----	-------	--------

	DIAMETER	HEIGHT
4.	2 ft. 4 in.	4 ft.

5.	6.25 ft.	8.5 ft.
----	----------	---------

6.	6 ft.	14 ft.
----	-------	--------

7. Mr. Merriam has a silo 17.5 ft. in diameter and 25 ft. high. What is its capacity in cubic feet?

8. How many gallons of water will be required to fill a kettle whose diameter is 14 in. and whose height is 12 in.?

9. A water tank by the side of a railroad track is 12 ft. in diameter and 15 ft. high. Find its capacity in gallons.

10. A copper hot water boiler is 15 in. in diameter and 4 ft. high. How many square feet of copper were required to make it? What is the capacity of the boiler in gallons?

11. An iron ash can whose base covers 3½ sq. ft. is 2 ft. 4 in. deep. Find its capacity.

PERCENTAGE

Oral

The expression per cent means by hundredths.

Thus, 3 per cent of a dollar means 3 hundredths, or 03, of a dollar.

The sign % means the same as the expression per cent. Thus, 7 % of a dollar and 7 per cent of a dollar mean the same thing — 7 hundredths, or .07, of a dollar.

1. Into how many hundredths can a dollar be separated? A ton of coal? A yard of cloth? Anything?

47 3/4
36 1/2
36 1/2
29 0
36 1/2
62 1/2

PER CENT AND FRACTIONAL EQUIVALENTS 237

2. What per cent of a dollar is 1 cent? 10 cents? 25 cents? 50 cents? 75 cents? 80 cents? 100 cents?

3. What part of a whole thing is 1 % of it? 10 % of it? 25 % of it? 50 % of it? 75 % of it? 100 % of it?

4. What per cent of a whole thing is $\frac{1}{2}$ of it? $\frac{1}{4}$ of it? $\frac{1}{5}$ of it? $\frac{1}{10}$ of it? $\frac{2}{10}$ of it? $\frac{3}{10}$ of it? $\frac{4}{10}$ of it? $\frac{5}{10}$ of it?

5. A man bequeathed 60 % of his estate to his family, and the balance equally to four charitable institutions. What per cent of the estate to each institution?

6. A dealer in farm supplies sold $\frac{3}{4}$ of his stock of seeds in the spring, 25 % in the summer, and the remaining part in the fall. What per cent in the fall?

17 1/2
34 8 1/2

PER CENT AND FRACTIONAL EQUIVALENTS

2 % = $\frac{1}{50}$	20 % = $\frac{1}{5}$	62 $\frac{1}{2}$ % = $\frac{5}{8}$
4 % = $\frac{1}{25}$	25 % = $\frac{1}{4}$	66 $\frac{2}{3}$ % = $\frac{2}{3}$
5 % = $\frac{1}{20}$	30 % = $\frac{3}{10}$	70 % = $\frac{7}{10}$
6 $\frac{1}{4}$ % = $\frac{1}{16}$	33 $\frac{1}{3}$ % = $\frac{1}{3}$	75 % = $\frac{3}{4}$
8 $\frac{1}{8}$ % = $\frac{1}{12}$	37 $\frac{1}{2}$ % = $\frac{3}{8}$	80 % = $\frac{4}{5}$
10 % = $\frac{1}{10}$	40 % = $\frac{2}{5}$	83 $\frac{1}{3}$ % = $\frac{5}{6}$
12 $\frac{1}{2}$ % = $\frac{1}{8}$	50 % = $\frac{1}{2}$	87 $\frac{1}{2}$ % = $\frac{7}{8}$
16 $\frac{2}{3}$ % = $\frac{1}{6}$	60 % = $\frac{3}{5}$	90 % = $\frac{9}{10}$

NOTE. This table must be memorized.

1. Subtract each of the per cents in the table from 100 %.

2. Subtract each fraction from 1 and express the result as per cent.

125 % = $1\frac{25}{100}$ = 1.25.

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3. Express decimally :

$$120\% \quad 137\frac{1}{2}\% \quad 166\frac{2}{3}\% \quad 100\% \quad 105\% \quad 106\frac{1}{4}\% \\ 150\% = \frac{150}{100} = \frac{3}{2}.$$

4. Express as common fractions :

$$125\% \quad 140\% \quad 162\frac{1}{2}\% \quad 116\frac{2}{3}\% \quad 108\frac{1}{3}\% \quad 105\%$$

5. Express as per cents :

$$\frac{3}{4} \quad \frac{1}{3} \quad \frac{5}{4} \quad \frac{6}{5} \quad \frac{7}{6} \quad \frac{8}{5} \quad \frac{11}{10} \quad \frac{13}{12} \quad \frac{23}{20} \quad \frac{27}{25} \quad \frac{53}{50} \\ \frac{3}{4}\% = \frac{1}{4} \text{ of } 1\% = .00\frac{1}{4}.$$

6. Express decimally :

$$\frac{1}{2}\% \quad \frac{3}{4}\% \quad \frac{2}{5}\% \quad \frac{1}{6}\% \quad \frac{7}{8}\% \quad \frac{2}{3}\% \quad \frac{1}{10}\% \\ 1\% = \frac{1}{100}. \quad \frac{2}{5}\% = \frac{2}{5} \text{ of } \frac{1}{100} = \frac{2}{500}.$$

7. Express as common fractions :

$$\frac{1}{2}\% \quad \frac{1}{4}\% \quad \frac{2}{3}\% \quad \frac{1}{6}\% \quad \frac{1}{5}\% \quad \frac{1}{8}\% \quad \frac{1}{10}\% \quad \frac{1}{12}\%$$

TERMS USED IN PERCENTAGE

There are three terms used in every problem in percentage :

- (1) The Whole, or the Base.
- (2) The Part, or the Percentage.
- (3) The Value of the Part, or the Rate Per Cent.

The whole, or the base, is the number or quantity of which a certain number of hundredths is taken.

The part, or the percentage, is the part of the whole taken.

The value of the part, or the rate per cent, is the number of hundredths of the whole taken.

There are three classes of problems in percentage :

I. The whole and the value of the part given to find the part.

FINDING THE PART, OR THE PERCENTAGE 239

What is 25 % of \$80 ?

$$(1) \ 25\% = .25 = \frac{1}{4} = \frac{1}{4} \text{ of } \$80 = \$20.$$

$$(2) \begin{array}{r} \$80 \\ \times .25 \\ \hline \$20.00 \end{array}$$

II. The whole and the part given to find the value of the part.

\$20 is what per cent of \$80 ?

$$(1) \ \frac{20}{80} = \frac{1}{4} = \frac{1}{4} \times 100 = 25\% \qquad (2) \ .25 = 25\%$$

III. The part and the value of the part given to find the whole.

\$20 is 25 % of what amount ?

$$(1) \ \$20 \text{ is } .25, \text{ or } \frac{1}{4}, \text{ or } \frac{1}{4} \text{ of what?} \qquad (2) \ .25 \overline{) \$80} = 25 \overline{) \$2000}$$

\$20 is $\frac{1}{4}$; $\frac{1}{4}$, or the whole, is \$80.

FINDING THE PART, OR THE PERCENTAGE Oral

Find:

1. 50 % of 84 bushels of corn; 25 %.
2. 75 % of 80 acres of land; 20 %.
3. 40 % of 60 quarts of milk; 60 %.
4. 80 % of 120 bushels of wheat; 10 %.
5. 30 % of 30 dollars; 70 %.
6. 90 % of 160 dozen eggs; $12\frac{1}{2}$ %.
7. $37\frac{1}{2}$ % of 56 tubs of butter; $62\frac{1}{2}$ %.
8. $87\frac{1}{2}$ % of 48 cases of lard; $33\frac{1}{3}$ %.
9. $66\frac{2}{3}$ % of 72 pounds of beef; $16\frac{2}{3}$ %.
10. $83\frac{1}{3}$ % of 72 baskets of grapes; $8\frac{1}{3}$ %.
11. $6\frac{1}{4}$ % of 80 pounds of coffee; 5 %.

2231
1

12. 4% of 200 hours; $2\frac{1}{2}\%$.

13. $\frac{1}{2}\%$ of 600 dollars; $\frac{2}{3}\%$.

Find $16\frac{2}{3}\%$; then 25%; $33\frac{1}{3}\%$; 50%; $66\frac{2}{3}\%$; 75%; $83\frac{1}{3}\%$ of:

14. \$12 \$48 \$84 \$24 \$108 \$182 \$240

15. \$36 \$60 \$96 \$72 \$120 \$144 \$300

16. What is $1\frac{1}{2}$ times \$40? What is 150% of \$40?

Find:

17. 125% of \$24; of \$36. 18. 120% of \$30; of \$80.

19. $133\frac{1}{3}\%$ of \$27; of \$45. 20. $116\frac{2}{3}\%$ of \$60; of \$72.

21. 110% of \$50; of \$90. 22. $112\frac{1}{2}\%$ of \$80; of \$56.

23. $108\frac{1}{3}\%$ of \$48; of \$60. 24. 105% of \$60; of \$80.

25. What is 1% of 400? What is $\frac{1}{2}\%$ of 400?

Find:

26. $\frac{1}{3}\%$ of \$600; of \$1200.

27. $\frac{1}{4}\%$ of \$800; of \$3200.

28. $\frac{1}{5}\%$ of \$1000; of \$4000.

29. $\frac{1}{6}\%$ of \$1200; of \$7200.

30. $\frac{1}{7}\%$ of \$2800; of \$5600.

31. $\frac{1}{8}\%$ of \$2400; of \$5600.

32. $\frac{1}{9}\%$ of \$3600; of \$6300.

33. $\frac{1}{10}\%$ of \$4000; of \$9000.

DRILL EXERCISES

12	48	72
24	Find	96
132	50 %	120
108	of	144
36	60	84

100	50	200
400	Find	150
250	10 %	350
450	of	500
550	600	300

16	48	80
32	Find	160
112	12½ %	96
144	of	176
128	64	192

In the center space
use 25 %; 75 %; 83½ %;
66⅔ %; 16⅔ %; 88⅓ %;
8⅓ %; 125 %; 175 %;
etc.

In the center space
use 2 %; 4 %; 5 %;
20 %; 25 %; 30 %;
40 %; 50 %; 60 %;
70 %; 75 %; 80 %;
90 %; 102 %; 104 %;
etc.

In the center space
use 37½ %; 62½ %;
87½ %; 25 %; 50 %;
75 %; 6¼ %; 137½ %;
162½ %; etc.

ORAL PROBLEMS

1. Three boys cleared the sidewalk of snow. What per cent of the pay should each get?
2. Mr. Howard cut 36 tons of hay and sold 75 % of it. How many tons did he sell?
3. Mr. Gordon raised 60 bushels of turnips and 20 % as many beans. How many bushels of beans?
4. Ward has 48 chickens and Kenneth 33⅓ % more. How many has Kenneth?
5. How many tons of fertilizer has a dealer left after selling 66⅔ % of a carload of 30 tons?
6. A cow that cost \$56 was sold at a gain of 12½ %. What was the gain? What was the selling price?

7. How many days in $83\frac{1}{3}\%$ of the month of November? In 70% ? In $66\frac{2}{3}\%$? In 50% ? In 60% ?

8. Stephen paid 96 cents for a geography and $62\frac{1}{2}\%$ as much for a grammar. How much for his grammar? For both?

9. Of \$400 paid for repairs, the carpenter received 80% , the roofer 25% , the plumber 20% , the painter 15% , and the tinsmith 10% . How much was paid to each?

10. Find:

$8\frac{1}{3}\%$	10%	$12\frac{1}{2}\%$	$16\frac{2}{3}\%$	20%	25%
90%	1. Of \$120		6. Of 600 shovels		30%
$87\frac{1}{2}\%$	2. Of \$240		7. Of 720 hoes		$33\frac{1}{3}\%$
$83\frac{1}{3}\%$	3. Of \$2.40		8. Of 840 rakes		$37\frac{1}{2}\%$
80%	4. Of \$3.60		9. Of 960 scythes		40%
75%	5. Of \$4.80		10. Of 1200 forks		50%
70%	70%	$66\frac{2}{3}\%$	$62\frac{1}{2}\%$	60%	50%

WRITTEN PROBLEMS

X 1. A farmer raised 325 chickens and sold 68% of them. How many did he sell?

X 2. Mr. Fletcher hired a neighbor to cut his hay for 15% of the crop. If the crop was 37 tons, how many tons did the neighbor get?

X 3. Mr. Leighton sold 75% of his crop of 288 bushels of potatoes at 65 cents a bushel. How much did he receive for them?

4. A farmer has in his barn 650 bushels of grain, of which 46 % is corn, 38 % oats, and the remainder wheat. How many bushels of each kind of grain?

5. Of the 80 animals on a farm, 5 % are horses, 15 % cows, 35 % pigs, and 45 % sheep. How many animals of each kind?

6. A merchant having 576 tubs of butter sold 25 % of it to one grocer, $16\frac{2}{3}$ % to another, $37\frac{1}{2}$ % to a third, and $8\frac{1}{3}$ % to a fourth. How many tubs to each grocer? How many tubs had he left?

7. A farmer raised 72 bushels of seed corn. After selling $37\frac{1}{2}$ % to Mr. Bean and $33\frac{1}{3}$ % to Mr. Holmes, how many bushels had he left?

8. In a civil service examination 76 % of the 175 applicants passed. How many passed?

9. By spraying his apple trees a farmer increased his crop 28 %. If he harvested 250 barrels in the year before spraying, how many barrels did he get the next year?

10. How many acres are left after 36 % of a farm of 350 acres is sold?

11. A man owing \$168 paid 65 % of it in June and the rest in July. How much did he pay in June? In July?

12. Four per cent of a piece of cloth measuring 75 yards was spoiled in weaving. How many yards were good?

13. An ocean steamship sailed 542 miles on Tuesday and 85 % as many miles on Wednesday. How many miles on both days?

14. A merchant sold a lot of blankets for \$270. Of this 24 % was profit. Find the profit.

15. Frank has a collection of 850 foreign postage stamps. How many will he have after selling 22 % of them?

16. On May 1 a merchant had in stock 1250 yards of gingham, and 825 yards of muslin. How many yards of each had he after selling 86 % of each kind?

17. Mr. Adams bought a flock of 225 sheep and sold 56 % of them to Mr. Martin. How many did Mr. Martin buy? How many had Mr. Adams left?

18. Mr. Watson has a pasture 80 rods by 64 rods, and a garden $6\frac{1}{4}$ % as large. How many acres in the pasture? In the garden?

19. A real estate dealer bought a lot of land containing 43,560 square feet. How many square feet had he after buying another lot containing 75 % as much?

20. A vessel lost 29 % of its cargo of 9500 bushels of wheat in a storm. How many bushels did it bring to port?

21. By the census of 1900 the population of a city was 12,375. By the census of 1910 it was 36 % more. What was the population in 1910?

FINDING THE VALUE OF THE PART, OR THE RATE PER CENT

Oral

1. What part of 100 is 1? 3? 9? 27? 51? 83? 100?

2. How many hundredths of 100 is 1? 3? 5? 7? 50? 82? 100?

3. What per cent of 100 is 1? 2? 5? 25? 62? 75? 100?

4. What part of 40 is 8? How many hundredths? What per cent?

5. What part of 24 is 12? Express your answer (1) as a common fraction; (2) as a decimal; (3) as a per cent.

6. In like manner express as parts of 24: 8 16 6
18 4 20 3 9 15 21 2

7. What per cent of \$72 is \$36? \$24? \$18? \$54?
\$12? \$60? \$9? \$27? \$45? \$63? \$8? \$6?

Express as per cents of:

8. A gallon: 2 quarts; 3 quarts; 1 pint; 1 quart
1 pint.

9. A bushel: 1 peck; 2 pecks; 3 pecks.

10. A peck: 1 quart; 3 quarts; 5 quarts; 6 quarts.

11. An inch: 6 inches; 8 inches; 9 inches; 10
inches.

12. A yard: 1 foot 6 inches; $\frac{3}{4}$ of a foot; $\frac{1}{2}$ of a foot;
2 feet 6 inches.

13. An acre: 40 square rods; 4 square rods; 100
square rods.

14. A mile: 40 rods; 80 rods; 200 rods; 160 rods;
32 rods.

15. Giving answers by groups, tell what per cent of
\$100 is:

\$ 50	\$ 25	\$ 20	\$ 16 $\frac{1}{2}$	\$ 12 $\frac{1}{2}$	\$166 $\frac{2}{3}$
\$100	\$125	\$120	\$116 $\frac{2}{3}$	\$137 $\frac{1}{2}$	\$187 $\frac{1}{2}$
\$150	\$175	\$180	\$133 $\frac{1}{3}$	\$162 $\frac{1}{2}$	\$200

16. Express as per cents of 4: 4 5 6 7 8

17. What per cent of 24 is 12? 24? 32? 40? 30?
42? 28? 44? 27? 33? 39? 45? 48?

30	20	40	15	45	12	24	36	48	10
60	What per cent of 60 is								50
57	39	27	21	9	3	54	42	18	6

Use 30 in the center space. Use 90.

ORAL PROBLEMS

1. What per cent of his money does Arthur save if he puts in the school savings bank 1 cent out of every 10 that he earns? If he puts in 2 cents? 4 cents? 5 cents?

2. Maria earns 25 cents each week. She saves 3 cents out of every 5 that she earns. What per cent does she save? How much does she save?

3. Out of 20 sessions of school Caroline was absent 1. What was her per cent of attendance?

4. Mr. Sampson planted his 24-acre lot as follows: 12 acres to corn, 8 acres to potatoes, and 4 acres to cabbages. What per cent of the lot was planted to each?

5. Emma and Winifred played 12 games of croquet. Emma won 4, and Winifred the rest. What per cent of the games did Winifred win?

6. What is the standing in per cent of a baseball team that loses 9 of the 24 games played?

7. Mr. Magoon's cow gives 8 quarts of milk in the morning and 12 quarts at night. The night's milking is what per cent of the whole quantity?

8. A grocer bought a 48-gallon barrel of kerosene and sold 46 gallons at once. What per cent of the barrel had he left?

9. Of the 27 votes cast by the common council for superintendent of streets, 18 were cast for Mr. Hume. What per cent of the members voted for Mr. Hume?

10. In the sixth grade there are 30 girls and 20 boys. What per cent of the pupils are girls? Boys?

11. The teacher gave 4 examples in arithmetic on Monday, 5 on Tuesday, 6 on Wednesday, and 10 on Thursday. The number given each day was what per cent of the total number given?

12. Alice solved all but 1 of the 25 examples given to the class. What per cent did she solve? Sherman solved 20. What per cent did he fail? Clara solved 22. What per cent?

13. In making a piece of machinery, one man worked 4 hours, another 6 hours, a third 8 hours, a fourth 12 hours, and a fifth 18 hours. What per cent of the work was performed by each?

WRITTEN PROBLEMS

1. A farmer sold 56 of his 175 sheep. What per cent of his flock did he sell?

2. From a case of cereal (144 packages) there were sold 108 packages. What per cent?

3. Ninety-nine of the 220 pages of an arithmetic are given up to drill exercises. The drill exercises are what per cent of the book?

~~4~~4. Fred had a kite string 750 feet long and lost 270 feet. What per cent?

5. A merchant having 180 chests of tea sold 153 of them. What per cent of his stock did he sell?

~~6~~6. A dry-goods dealer paid \$228 for newspaper advertising and \$78 for circulars. How much did his advertising cost? What per cent of this was paid for advertising in newspapers? What per cent for advertising by circulars?

7 In draining his land, Mr. Dean used 406 feet of pipe in one field and 294 feet in another. What per cent of the pipe used was laid in each field?

8 In a test at an agricultural station it was found that 132 of the 150 beet seeds planted produced plants. What per cent was good?

9. A farm is divided as follows: 4 acres in home lot and buildings, 20 acres in pasture, 40 acres in grass, 10 acres in alfalfa, 32 acres in corn, 16 acres in oats, 8 acres in wheat, 24 acres in potatoes, and 6 acres in miscellaneous crops. What per cent of the farm is given to each?

~~10~~10. It is 90 miles from New York to Philadelphia, 95 miles from Philadelphia to Baltimore, and 40 miles from Baltimore to Washington. In going from New York to Washington, what per cent of the trip is completed when Philadelphia is reached? Baltimore? Washington?

11. What is the per cent of gain in buying apples at 50 cents a bushel and selling at 80 cents a bushel?

HINT. What is the gain? The gain is what part of the cost?

The per cent of gain or loss is always reckoned on the cost.

12. A man bought a cow for \$80 and sold it for \$60. What was his per cent of loss?

13. A market man bought cranberries at \$2.50 per bushel and sold them at 80 cents a peck. What per cent did he gain?

14. What is the per cent of profit when 5 plows are bought for \$75 and sold at \$18 apiece?

15. A drover bought 8 cows at \$62.50 apiece, and sold them for \$620. What was his gain per cent?

16. A box of mucilage (3 dozen bottles) is bought for \$1.26 and retailed at 5 cents a bottle. What is the gain per cent?

FINDING THE WHOLE, OR THE BASE

Solve:

1. 12 is 25% of 48.
2. 10 is 20% of 50.
3. 18 is 50% of 36.
4. 8 is $16\frac{2}{3}$ % of 48.
5. 15 is 75% of 20.
6. 16 is 40% of 40.
7. 20 is $33\frac{1}{3}$ % of 60.
8. 48 is $66\frac{2}{3}$ % of 72.
9. 9 is $12\frac{1}{2}$ % of 72.
10. 30 is $83\frac{1}{3}$ % of 36.
11. 15 is $37\frac{1}{2}$ % of 40.
12. 36 is 60% of 60.
13. 25 is $62\frac{1}{2}$ % of 40.
14. 28 is $87\frac{1}{2}$ % of 32.

ORAL PROBLEMS

1. Arthur sold 12 of his doves, or 25% of his flock. How many had he at first? 48 doves

2. \$30 is $16\frac{2}{3}$ % of the money Albert has in the bank. How much has he in the bank?

3. Two weeks, or $12\frac{1}{2}$ %, of the school term have passed. How many weeks in the term?

51
357

4. Mr. Wells sold 36 tons of alfalfa, or 75 % of his crop. How many tons did he raise?
5. A farmer sold 20 % of his stock. He then had 24 head. How many had he at first?
6. Mr. Watson has 60 sheep, or 80 % of his flock, in the pasture, and the rest in the barn. How many in the barn?
7. A suit cost \$27. This was 90 % of the cost of a coat. Find the cost of the coat.

WRITTEN PROBLEMS

8. A farmer sold his horse at a gain of \$30, or 25 %. Find the cost.

(1) \$30 is $\frac{1}{4}$ of the cost,
 $\frac{1}{4}$, or the whole, is 4 times \$30, or \$120.
 \$120

(2) $.25\$30 = 25\3000 .

9. When Mr. Blackburn sold his cow for 15 % more than he paid, he gained \$12. How much did the cow cost?

10. A mowing machine was sold at a loss of \$14, or 40 %. Find the cost.

11. If Mr. Peters sells his house for \$4500, he will gain 20 % of the cost. Find the cost.

HINT. \$4500 = what per cent?

12. A clerk had his weekly wages increased \$3, or $16\frac{2}{3}$ %. What were his wages before the increase? After the increase?

13. A merchant sold 123 barrels of flour, or 82 % of his stock, in one day. How many barrels had he at first?

14. What is the cost of a fountain pen if a profit of 15% is made by selling it for 69 cents?
15. Find the cost of a piano sold at a profit of \$108, or 45%.
16. What wages does a man receive weekly if he spends 80%, or \$19.20, for living expenses?
17. If 65% of a barrel of sugar is 195 pounds, what is the weight of a full barrel?
18. A ranchman lost 3000 sheep in a blizzard. If this was 24% of his herd, how many had he at first?
19. A plow sold for \$15 gives a profit of 25%. Find the cost.
20. A harrow sold for \$15 gives a loss of 25%. Find the cost.
21. A farmer sold two cows for \$72 each. On one he gained 20%, and on the other he lost 20%. Did he gain or lose by the sale? How much?

ORAL EXERCISE

Find the missing term:

	COST	SELLING PRICE	GAIN	LOSS	GAIN %	LOSS %
1.	\$24		\$3		12½	
2.	\$40	\$32				20
3.	\$30		\$5		16⅔	
4.		\$36		\$4		10⅔
5.	\$35		\$7		20	
6.	\$27	\$36			33⅓	
7.		\$32	\$8		33⅓	
8.	\$35	\$60			25	

WRITTEN EXERCISE

Find the missing term :

	COST	SELLING PRICE	GAIN	Loss	GAIN %	Loss %
1.	\$120		?		15	
2.	\$350			?		8
3.	\$270	\$800			?	
4.	\$147	\$140				?
5.		\$630	\$70		?	
6.		\$225		\$25		?
7.	\$800	?			10 $\frac{1}{2}$	
8.	\$240	?				20
9.	\$12.50	?			32	
10.	\$18.25	\$21.90			?	
11.		\$21	\$4.20		?	
12.	\$2.80	?			37 $\frac{1}{2}$	
13.	\$6.50			?		18
14.	\$8.40	?				15
15.		\$42		\$4.50		?
16.	\$812	?				7

MISCELLANEOUS PROBLEMS

1. Mr. Barker paid \$4875 for a house which he sold a month later for 8% more than he paid. Find the selling price.

2. An alloy is composed of 18 parts silver and 7 parts copper. What per cent of the alloy is silver? What per cent copper? How many pounds of each metal in an alloy weighing 1200 pounds?

3. What is the loss when an automobile that cost \$1800 is sold for 58% of the cost?

4. The population of a city in 1909 was 12,800; in 1910, 5 % more; in 1911, 5 % more than in 1910. Find the population in 1911.

5. Mr. Sayles bought a cow for \$84 and sold it at a profit of \$12. What was his gain per cent?

6. A merchant bought 45 rugs for \$113.75, and sold them at a gain of 20 %. How much did he receive for each rug?

7. In a city of 80,000 people 20 % are of school age, but only 80 % of the children of school age attend school. How many pupils in school?

8. A house lot costing \$1750 was sold for 92 % of the cost. Find the selling price.

9. Gunpowder is 75 % saltpetre, 10 % sulphur, and 15 % charcoal. How many pounds of each material must be used to make a ton of gunpowder?

10. A watch costing \$42 was sold at a loss of $12\frac{1}{2}$ %. What was the selling price?

11. A bricklayer formerly laid 1000 brick a day. By a scientific handling of materials, he can now lay 2700 a day. What is the per cent of increase?

12. Mr. Adams bought a house for \$3750 and sold it at a gain of $16\frac{2}{3}$ %. Find the selling price.

13. What is the gain per cent when wood is bought for \$6.75 per cord and sold for \$8 per cord?

14. A salesman receives a salary of \$1200 and 5 % on all sales. What is his income in a year in which he sells \$18,000 worth of goods?

15. A platform scale sold for \$13.94 allows a profit of \$3.69. What per cent?

16. How much must a dealer in farm supplies get for a hay rake costing \$16.75 to make a profit of 30 % ?
17. Henry buys newspapers at the rate of 2 for a cent and sells them at a cent apiece. Find his gain per cent.
18. A cotton mill has in its storehouse 4284 bales of cotton. If it uses $16\frac{2}{3}$ % of its stock in a week, how long will the supply last? How many bales are used each week?
19. What is the loss in selling a horse that cost \$165 for 7 % less than cost?
20. Mr. Appleton paid \$27.50 for a disc cultivator, and at the end of the season sold it for \$16.50. What per cent of the cost did he receive?
21. A man built a house for \$3750 and sold it for \$675 above cost. What per cent did he gain?
22. Twelve per cent of an alloy is tin, and the rest copper. How many pounds of copper in 245 pounds of the alloy?
23. A galvanized steel grain tank that can be made for \$24 is sold for \$32.60. What per cent does the dealer make?
24. A picture dealer paid \$18 for a picture and \$6 for the frame. He sold both at a gain of 45 %. Find the selling price.
25. A farmer bought 60 sheep at \$4.50 apiece and sold them for \$360. What was the gain per cent?
26. If green coffee loses $8\frac{1}{3}$ % of its weight in roasting, how many pounds of roasted coffee will be produced from 375 pounds of green coffee?

27. What is the gain per cent in buying wheat at 90 cents a bushel and selling at \$1.05 a bushel?

28. A barrel of flour (196 pounds) is put up in bags of $24\frac{1}{2}$ pounds. A bag of flour is what per cent of a barrel?

29. "Kind hearts are more than coronets,
And simple faith, than Norman blood."

What per cent of the words in this couplet are words of 3 letters? Of 4 letters? Of 5 letters? Of 6 letters? Of 8 letters?

HOME PROBLEMS

X 1. What premium does Mr. Shea pay for insuring his house for \$3500 for five years at \$0.75 per \$100 of insurance?

2. A house is insured for \$3200 for five years at $\frac{7}{8}\%$. What amount must the owner charge each year in his cash account for protection?

X 3. What tax is assessed on property valued by the assessors at \$3800 if the tax rate is \$1.95 per \$100 of valuation?

4. What is Mr. Parr's tax on property assessed at \$5450 if the tax rate is \$19.60 per \$1000.

X 5. Mr. Hogan petitions for a sidewalk in front of his home. The city lays it at a cost of \$0.84 per square yard and assesses Mr. Hogan for one-half of the cost. What is Mr. Hogan's assessment if his lot has a frontage of 72 ft. and the sidewalk is 10 ft. wide?

6. The sum of \$3000 is assessed on the abutters for improvements in a street 1250 ft. long. What is the assessment of Mr. Bernstein, whose lot abuts 60 ft. on the street?

X 7. A sewer is laid in a street at a cost of \$3.84 per running foot. If the city bears 50% of the cost, what is the assessment of a property owner whose lot has a frontage of 80 ft.?

8. If a family allows 20 % of its income for rent, what monthly rent can it afford to pay if its annual income is \$1560?

9. Mrs. Cluin rents a house at \$37.50 per month, subletting one room at \$8.50 per month and another at \$7.75 per month. Find the annual expense to Mrs. Cluin for the rent of her own apartments.

10. A family rents a house for \$282, payable in quarterly instalments. What is the amount of each payment? How much must the family save out of its monthly earnings to meet payments as they become due?

11. Mr. Olney buys a house and lot for \$3800, paying down \$1600 and agreeing to pay the balance in rent at the rate of \$25 per month. How long will it take him to pay for the property?

12. Mr. McElroy bought a home for \$4500, paying down 40 % of the price and agreeing to pay the balance in eight quarterly payments. What was the amount of each quarterly payment? If he bought the home on April 15, 1911, when did he make the last payment?

13. Mr. Jarvis invests \$4500 in a piece of real estate. What monthly rental must he get to realize 7 % on his investment if he allows, annually, \$72 for taxes, \$7.50 for water rates, \$4.50 for insurance, and \$30 for repairs?

14. The decorator's charges for papering a room were: 12 rolls paper at 25c, 21 yd. cut-out border at 11c, 15 lb. paste at 2c, $6\frac{1}{2}$ hours' labor at 47c. Make out the bill.

15. A house owner wishes to connect with the city sewer. He finds that the city's charge for opening the sewer is \$8, that the pipe will cost \$32, other material \$7.36, and that it will require 6 days' labor at \$2.25, and 1 day's labor at \$3.75. Compute the cost.

16. Find the total expense of the following items taken from Mr. Barker's cash book for one year: taxes, $1\frac{3}{4}\%$ on a valuation of \$4800; insurance, $\frac{3}{4}\%$ on \$3000 for a five-year policy; assessment for betterments, \$53.80; water charges, \$8.25; lighting for year, average bill \$2.85 per month; telephone for year at \$2.25 per month; fuel, \$88.75.

17. Mr. Stanley's tax bill shows that the assessors value his house and lot at \$5900. The rate of tax is \$20.80 per \$1000, with a discount of 2% if paid before Oct. 20. If Mr. Stanley pays Oct. 27, how much will he pay? How much if he pays Oct. 19?

REAL ESTATE PROBLEMS

Mr. Ballard bought a lot of land for \$1200 and built a 4-tenement house upon it for \$4800.

1. The first year after it was built he rented each tenement for \$25 a month, and paid \$75 for taxes and insurance. What was the gross income? The net income? The net income was what per cent of the cost?

2. The second year he rented each tenement for \$24 a month, paid \$75 for taxes and insurance, and \$27 for repairs. What was his net income? This was what per cent of the cost?

3. The third year he rented one tenement for the year at \$23 a month, one for 8 months at \$20 a month, one for the year at \$20 a month, and one for 10 months at \$23 a month. He paid \$75 for taxes and insurance, and \$69 for repairs. The net income was what per cent of the cost?

4. The fourth year he received an average rental of \$75 a month from the property, and paid \$75 for taxes and insurance, and \$225 for repairs. What per cent income?

5. The fifth year he received an average monthly rental of \$17.50 from each tenement, and paid \$75 for taxes and insurance, and \$285 for repairs. What per cent income?

6. At the end of the fifth year he sold the property at auction for \$5800, and paid the auctioneer \$100 for his services. What per cent of the cost did he receive?

7. He then bought a farm of $60\frac{1}{2}$ A. at \$72 an acre, and spent a sum equal to 20 % of the cost in repairs. Find the total amount expended.

8. The following year he sold the farm at a profit of $\frac{1}{3}$ of the total cost. How much did he receive for it?

BASEBALL PROBLEMS

The regulation baseball "diamond" is a 90-foot square.

1. Draw one on a scale of 1 inch to 30 feet. Mark the home plate *H*, and the bases 1, 2, 3.

2. How many square feet does the infield cover? What part of an acre?

3. How far does a player run in making a "home run?" What part of a mile?

4. The record time for a "home run" is 14 seconds. How many feet in a second?

5. A "home run" is how much longer than a hundred-yard dash?

6. The record time for a hundred-yard dash is $9\frac{1}{2}$ seconds. How many feet in a second?

7. The pitcher's "plate" is a rectangle 6 inches by 2 feet, the long side toward the home plate. What is its area in square feet? In square inches?

8. The distance from the front of the pitcher's "plate" to the rear of the home plate is 60.5 feet. The distance from the rear of the pitcher's "plate" to the center of second base is 66 feet 4 inches (nearly). How long a throw from "home" to "second"?

9. A ball is batted to "second," caught and thrown to "first," then thrown "home." How far has the ball gone?

10. In a certain number of games a left fielder had 36 chances and accepted 32. What was his fielding average?

11. Out of 132 times at bat, a player made 33 hits. What was his batting average?

FINAL STANDING NATIONAL LEAGUE — 1916

Clubs	Brooklyn	Philadelphia	Boston	New York	Chicago	Pittsburg	St. Louis	Cincinnati	Games Won
Brooklyn.....	..	11	9	15	15	14	15	15	
Philadelphia ..	11	..	11	13	14	13	12	17	
Boston.....	13	11	..	11	14	14	13	13	
New York.....	7	9	10	..	12	17	15	16	
Chicago.....	7	8	7	10	..	12	14	9	
Pittsburg	8	9	8	5	10	..	16	9	
St. Louis.....	7	9	9	7	8	6	..	14	
Cincinnati	7	5	9	5	13	13	8	..	
Games Lost									

12. Make a table showing the number of games lost, the number won, the total number played, and the per cent won by each club. Express the per cent to the nearest tenth: Thus, for Brooklyn, $\frac{94}{154} = .610 = 61\%$.

NATIONAL LEAGUE STATISTICS — 1916

Clubs	Times at Bat	Runs	Hits	2-Base Hits	3-Base Hits	Home Runs	Total Bases
Brooklyn ...	5234	585	1366	195	80	28	
Cincinnati ..	5254	505	1336	187	88	14	
New York ..	5152	597	1305	188	74	42	
Philadelphia	4985	581	1244	223	53	42	
St. Louis ...	5030	476	1223	155	74	25	
Pittsburg ...	5181	484	1246	147	91	20	
Chicago	5179	520	1237	194	56	46	
Boston	5075	542	1181	166	73	22	
Totals							

13. Find the total number of times at bat ; runs made ; base hits ; 2-base hits ; 3-base hits ; home runs.

14. Of the 1366 hits made by the Brooklyn team, 195 were 2-base hits, 80 were 3-base hits, and 28 were home runs. Find the total number of bases won by hits by the Brooklyn team ; by each of the other teams.

15. Baseball scorers find the batting per cent of a team by dividing the number of hits by the number of times at bat. Thus, the batting per cent of the Brooklyn team is found by dividing 1366 by 5234. Find the batting per cent of each team.

DISCOUNT

Oral

Mr. Wilson owes the doctor \$50. At the time of payment the doctor deducts 10% of the bill. How much is deducted?

For payment at the time of purchase a dry-goods dealer makes a deduction of 3 % from the amount of the bill. What deduction does he make on a bill of goods amounting to \$200?

A carriage maker asks \$60 for farm wagons. He makes a deduction of 20 % to other dealers. This is how much less than the regular price?

Any deduction from a regular or fixed price or amount is a *discount*.

Discounts are generally a per cent of the established price or amount.

The per cent of discount is the *rate of discount*.

Manufacturers and wholesalers issue price lists of their goods from which deductions are allowed. Such deductions are *commercial* or *trade discounts*.

Discounts are generally spoken of as so many "per cent off." Thus, a manufacturer speaks of the prices of plows as "\$12, 25 % off," meaning that he will deduct 25 % from the regular price, \$12, making the price to the retailer \$9.

The amount of the bill after the deduction is made is the *net* price.

Find the discount:

- | | |
|--------------------------------|---------------------------------|
| 1. \$50, 2 % off | 2. \$70, 10 % off |
| 3. \$30, 40 % off | 4. \$40, 5 % off |
| 5. \$48, $16\frac{2}{3}$ % off | 6. \$35, 20 % off |
| 7. \$36, $33\frac{1}{3}$ % off | 8. \$56, $12\frac{1}{2}$ % off |
| 9. \$32, 25 % off | 10. \$40, $37\frac{1}{2}$ % off |
| 11. \$60, 20 % off | 12. \$50, 8 % off |

13. The regular price of a chair is \$16. I can buy it 25 % less than the regular price. What is the discount? The net price?

14. At 20 % off, what is the discount on a bill of goods amounting to \$30?

15. Find the net price of a \$48 mowing machine, discount 16 $\frac{2}{3}$ %.

16. What is the net price of 5 books at \$2 each, 20 % off?

17. Lace marked \$0.40 a yard is sold at a discount of 12 $\frac{1}{2}$ %. What is the discount?

WRITTEN PROBLEMS

① Two boys bought a tent. The list price was \$24, with a discount of 30 %. How much did each boy pay?

② The list price of an automobile was \$2250. If a discount of 16 % was allowed, what was the net price?

③ A plumber's bill was \$176.50. For cash payment there was a discount of 2 %. What was the net amount of the bill?

④ The list price of a piano was \$450. It was sold at a discount of 40 %. What was the selling price?

⑤ On a stove listed at \$42 a discount of 22 % was allowed. What was the net price?

⑥ Find the net price of 60 pairs of blankets at \$2.50 a pair, with a discount of 15 %.

⑦ A shopworn set of histories was sold at 40 % off. The original price was \$25. What was the sale price?

8. A clothier advertises suits marked \$12.25 to be sold at a discount of 20%. How much does he expect to get for a suit?

9. A carload of hay containing $12\frac{3}{4}$ tons was bought at \$16 a ton, with a discount of 5% for immediate payment. What was the net price?

10. A coöperative grocery allows its shareholders a discount of 5% from the regular prices. What will a shareholder pay for a barrel of flour at \$6.40 and 3 tons of coal at \$7.20 a ton?

DISCOUNT SERIES

Oral

Sometimes manufacturers and wholesalers grant more than a single discount to purchasers. For instance, a manufacturer of saws may list a certain grade of saw at \$1.20 and then give the retailer a discount of 40% and an additional discount of 25%. In such cases the second discount is reckoned on the sum remaining after the first discount is made. Either of the following methods may be used in solving the above problem:

FIRST SOLUTION—

40% of \$1.20 = \$0.48, the first discount.

\$1.20 — \$0.48 = \$0.72, the list price less 40%.

The second discount, 25%, is then reckoned on \$0.72.

25% of \$0.72 = \$0.18, the amount allowed by the second discount.

\$0.72 — \$0.18 = \$0.54, the net price.

SECOND SOLUTION—

Since 40% is deducted, 60% is paid.

60% of \$1.20 = \$0.72, the price after the first discount.

Since a further discount of 25% is allowed, 75% of the price after the first discount, is paid. 75% of \$0.72 = \$0.54, the net price.

1. Find the net cost of a bill of goods to the amount of \$60 with successive discounts of 50 % and $33\frac{1}{3}$ %.
2. A furniture manufacturer lists desks at \$50 with successive discounts of 20 % and 10 %. Find the net price.
3. How much will pay for a rug listed at \$80 if successive discounts of 25 % and 20 % are allowed?

C.S. .
PROBLEMS*Written*

- ① A shoe dealer allows successive discounts of 30 % and 10 % on a certain style of shoe. What is the total discount allowed on a bill of goods to the value of \$600? What is the net price?
- ② A manufacturer of window glass gives successive discounts of 60 % and 40 %. Find the net cost of a shipment of glass listed at \$1250.
3. A city bought 48 sanitary drinking fountains listed at \$28.50 each, with successive discounts of 25 % and 5 %. Find the net cost.
4. On a bill of \$600 there were allowed successive discounts of 50 %, 20 %, and 10 %. Find the net cost. What was the total discount?
- ⑤ A dealer in ship supplies allows successive discounts of 40 % and 10 %, payment to be made in 60 days. He allows a further discount of 5 % for cash payment. What is the net cost to the purchaser of goods to the amount of \$1500 if he makes a cash payment? How much does he save by paying cash rather than by waiting 60 days?

6. To what single discount are successive discounts of 40 % and 20 % equal?

SOLUTION—

A discount of 40% leaves 60% to be paid.

A discount of 20% of the 60% leaves 48% to be paid.

100%—48% = 52%, the total net discount.

To what single discount are the following successive discounts equal?

- | | |
|-----|---------------|
| 7. | 40 % and 10 % |
| 9. | 20 % and 5 % |
| 11. | 60 % and 25 % |
| 13. | 50 % and 25 % |
| 15. | 25 % and 10 % |

- | | |
|-----|----------------------------|
| 8. | 20 % and $12\frac{1}{2}$ % |
| 10. | 30 % and 20 % |
| 12. | 25 % and $33\frac{1}{3}$ % |
| 14. | 40 % and $33\frac{1}{3}$ % |
| 16. | 20 % and 20 % |

COMMISSION

Oral

Mr. Harris sends 40 barrels of apples to Mr. White to sell for him. Mr. White sells them at \$3 a barrel. What is the selling price? For making the sale Mr. White receives 5 % of the selling price. How much does he receive? How much does Mr. Harris get?

The person for whom business is transacted is the *principal*.

The person transacting business for another is the *agent*.

The amount for which the goods are sold is the *gross proceeds*.

The amount paid to an agent for his services is the *commission* or *brokerage*.

The amount left after the commission and other charges are paid is the *net proceeds*.

1. At 5 % commission, how much is paid an agent for selling a horse for \$200? How much does the owner get?

2. Fred sells a box of soap among the neighbors for \$40 at 20 % commission. Find his commission. How much does the maker get ?

3. How much does Mr. Lake receive for selling a \$3000 automobile at 12 % commission ? Find the net proceeds.

4. Mr. Harvey paid a real estate agent \$100 for selling a house for \$2000. What per cent commission did he pay ? What were the net proceeds ?

5. What are the net proceeds when a commission merchant sells goods for \$600 at 4 % commission ?

6. An auctioneer sold a farm for \$3500 and received \$350 for his services. Find the per cent of his commission.

7. What were the gross proceeds of a sale of wheat if the net proceeds were \$2400 and the commission \$30 ?

WRITTEN PROBLEMS

1. At $1\frac{1}{4}$ % commission, find the amount paid an agent for selling 1675 bushels of wheat at 92 cents a bushel.

2. A real estate agent collects rents to the amount of \$1248. If his commission is $2\frac{1}{2}$ %, what per cent of the collections is returned to the owner of the property ? How much money ?

3. A bill collector collected the following amounts in one week : \$37.20, \$42.50, \$20.68, \$15.86, \$12.35, \$122.76, \$86.42, \$95.27, \$39.48, and \$112.50. Find his commission at $7\frac{1}{2}$ %.

4. At a commission of 5 % of the sum collected, how much does an agent receive for collecting 75 % of a bill of \$168 ?

X 6. A commission dealer sells 360 barrels of apples at $\$1\frac{1}{2}$ a barrel, receiving a commission of 3%. Find the commission; the net proceeds.

6. Mr. Hanley sent to a commission firm 450 bushels of corn and 620 bushels of potatoes. The corn was sold at 45 cents a bushel and the potatoes at 70 cents a bushel. The firm charged a commission of 3%, and \$8.72 for cartage. How much money was sent to Mr. Hanley?

7. What is the per cent commission when an agent receives \$150 for selling 240 cases of goods at \$12.50 a case?

8. Mr. Carter paid \$20 to Mr. Driver for selling 2 cows at \$75 each, and a horse for \$100. Find the per cent of the gross proceeds paid to Mr. Driver.

9. After selling a lot of land for \$3600, the agent kept \$288 for his services. This was what per cent of the sum received for the land?

10. An architect receives a commission of $3\frac{1}{2}\%$ for preparing the plans, and a commission of $2\frac{1}{2}\%$ for superintending the construction, of a building. What is his commission if the building costs \$87,500?

11. The net proceeds of a sale of farm products was \$672.32; the commission \$91.68. Find the rate of the commission.)

A GROUP OF SCHOOL PROBLEMS

1. In the Washington school there are 358 boys and 89 more girls than boys. How many pupils in the school?

2. The attendance was 784 on Monday, 776 on Tuesday, 769 on Wednesday, 775 on Thursday, and 766 on Friday. What was the average daily attendance?

3. There are 18 rooms in the building. Four have 54 seats each, six 48 seats each, and the rest 45 seats each. How many seats in all?

4. One hundred eighty-four tons of coal were required to heat the building. How much did it cost at \$5.68 a ton?

5. One of the janitors received \$2.25 a day and the other \$1.95 a day. Each worked 308 days in the year. How much was paid them?

6. In the Lincoln school there were 648 pupils in September. During the year 38 new pupils entered from out of town, 16 from other schools in town, 25 were transferred to other schools, 9 left on account of illness, and 36 to go to work. How many pupils at the close of the year?

7. John's marks for the year were 84 in arithmetic, 76 in grammar, 92 in spelling, 87 in geography, and 88 in history. What was his average?

8. Henry was absent 6 sessions in the fall, 5 in the winter, and $4\frac{1}{2}$ days in the spring. What part of the year of 56 weeks was he present? (Two sessions each day.)

9. There were 132 pupils in the fifth grade, and 119 in the sixth. How many in each grade after 17 were promoted from the fifth grade to the sixth, and 7 new pupils had entered the fifth grade and 4 had left the sixth grade?

10. Eight of the pupils lived outside the city, and each paid a tuition fee of \$12 for each of the three terms. How much did they all pay in the year?

11. Maud's mark for attendance was 95%. How many of the 360 sessions was she present?

12. Esther was present 360 sessions out of the whole number of 360 sessions. What was her per cent of attendance?

13. Ellen was absent 27 sessions. What was her per cent of attendance?

14. Each of the 98 pupils in the seventh grade purchased a geography for \$0.95, an arithmetic for \$0.65, and a grammar for \$0.56.

(a) How much did each pupil pay for his books?

(b) How much did all the geographies cost?

(c) How much did all the arithmetics cost?

(d) How much did all the grammars cost?

(e) What was the total amount paid by all the pupils?

Find this in two ways.

15. The average expense per pupil for books and supplies was \$1.87. What amount was expended for the pupils in the Washington school?

16. The pupils in a school are divided among the grades as follows: 180 in the fourth grade, 150 in the fifth, 120 in the sixth, 100 in the seventh, and 50 in the eighth. What part of the pupils in the school in each grade?

✓ 17. In another school there are 720 pupils. Ten per cent are in the eighth grade, 15 % in the seventh grade, 20 % in the sixth grade, 25 % in the fifth grade, and the rest in the fourth grade. How many in each grade?

✓ 18. In the Lee school there are 90 pupils in the eighth grade, 30 more in the seventh grade, 20 more in the sixth grade than in the seventh, 40 more in the fifth grade than in the sixth, and 40 more in the fourth grade than in the

fifth. How many in each grade? In the school? What per cent of the pupils in the school in each grade?

19. Of the 64 pupils in the highest grade of a grammar school, $87\frac{1}{2}\%$ received certificates of admission to the high school, and 75 % of those receiving certificates entered the high school. How many entered the high school?

20. The length of the high school session is 5 hours. Thirty minutes are given to recesses, and the rest of the time is divided into 6 equal periods. How many minutes to a period? What per cent of an hour?

DIFFERENCE IN TIME BETWEEN DATES

Find the difference in time between March 22, 1910, and Nov. 12, 1911.

	YEARS	MONTHS	DAYS
(1)	1911	11	12
	1910	8	22
	1	7	20

In this method a month is regarded as 30 days.

- (2) From March 22, '10, to March 22, '11 = 1 year
 From March 22, '11, to Oct. 22, '11 = 7 months
 From Oct. 22, '11, to Nov. 12, '11 = 21 days

This method gives the exact number of days less than one month.

Both the above methods are in common use. Use the one generally used by business men in your locality.

TABLE OF DAYS SPECIALLY OBSERVED AS HOLIDAYS

New Year's Day,	January 1.
Washington's Birthday,	February 22.
Peace Day,	May 18.
Flag Day,	June 14.
Independence Day,	July 4.
Labor Day,	First Monday in September.
Columbus Day,	October 12.
Thanksgiving Day,	Last Thursday in November.
Christmas Day,	December 25.

Find the time in months and days :

1. From New Year's Day to Christmas Day.
2. From Washington's Birthday to Peace Day.
3. From Washington's Birthday to Independence Day.
4. From Independence Day to the following Flag Day.
5. From Peace Day to Christmas Day.
6. From Christmas Day to the following Peace Day.
7. From to-day to next New Year's Day.
8. From to-day to each of the other days in the above list.

Find the difference in time between the following dates:

1. April 6, 1904, and Nov. 1, 1909.
2. Sept. 27, 1906, and March 3, 1909.
3. Nov. 28, 1905, and Aug. 15, 1909.
4. Jan. 13, 1906, and Aug. 7, 1911.
5. May 12, 1902, and Jan. 3, 1909.
6. Oct. 17, 1911, and Nov. 7, 1912.
7. Feb. 5, 1905, and March 3, 1908.
8. Dec. 29, 1910, and May 16, 1913.
9. March 21, 1906, and Aug. 17, 1911.
10. July 20, 1904, and Jan. 26, 1907.
11. Aug. 24, 1900, and March 12, 1912.
12. June 27, 1910, and April 5, 1913.

SIMPLE INTEREST

Mr. Campton owns a store worth \$4000. He lets Mr. Barker have the use of it for one year for 6% of its value. How much does Mr. Barker pay?

If Mr. Campton should let Mr. Barker have \$1000 in money for a year at 6%, how much would Mr. Barker pay for its use?

Money paid for the use of money is interest.

The sum of money for whose use interest is paid is the principal.

The per cent of the principal paid each year for interest is the rate.

The *legal* rate is the rate established by law in the state where the money is loaned. The legal rate in most states is 6%. What is the legal rate in the state in which you live? When no rate is mentioned, the legal rate is understood.

Mr. Stevens borrowed \$3000 for one year at 5%. At the end of the year he paid the \$3000 and the interest. What amount did he pay?

The sum of the principal and the interest is the amount.

SIGHT EXERCISES

Find the interest for one year on :

1. \$300 at 6%
2. \$800 at 5%
3. \$900 at 4%
4. \$700 at 3%
5. \$800 at 7%
6. \$500 at 8%
7. \$250 at 6%
8. \$150 at 8%
9. \$350 at 4%
10. \$240 at 5%
11. \$450 at 3%
12. \$900 at 7%

Find the interest on :

13. \$150 at 4% for 1 year; $\frac{1}{2}$ of a year; $1\frac{1}{2}$ years.
14. \$250 at 8% for 1 year; $\frac{1}{4}$ of a year; $\frac{3}{4}$ of a year; $1\frac{1}{4}$ years.

15. \$450 at 6% for 1 year; $\frac{1}{2}$ of a year; $\frac{2}{3}$ of a year; $1\frac{1}{3}$ years.

16. \$600 at 5% for 1 year; $\frac{1}{2}$ of a year; $\frac{5}{8}$ of a year; $1\frac{5}{8}$ years.

17. What part of a year is 6 months? 3 months? 9 months? 4 months? 8 months? 2 months? 10 months? 1 month? 5 months? 7 months? 11 months?

18. What is the interest on \$400 at 6% for 6 months? 3 months? 9 months? 4 months? 8 months? 2 months? 10 months? 1 month? 5 months? 7 months? 11 months?

Find the interest and the amount of:

19. \$800 for 6 months at 5% $\$20$

20. \$600 for 3 months at 8% $\$12$

21. \$900 for 1 month at 4% $\$3$

22. \$600 for 8 months at 3% $\$12$

WRITTEN PROBLEMS

1. What is the interest and the amount of \$576 for 2 years 7 months at 5%?

\$576, principal
<u>.05</u>
\$28.80, interest for 1 year
<u>$2\frac{7}{12}$ (2 years 7 months = $2\frac{7}{12}$ years)</u>
\$16.80
<u>57.60</u>
\$74.40, interest for 2 years, 7 months
576.00, principal
<u>\$650.40, amount</u>

Find the interest and the amount of:

2. \$490 for 1 year 9 months at 7%
3. \$867 for 2 years 4 months at 8%
4. \$1265 for 3 years 5 months at 6%
5. \$1468 for 4 years 6 months at 5%

THE ONE-DOLLAR METHOD

In computing simple interest a year is generally regarded as 12 months of 30 days each.

When the time is given in years, months, and days, or in months and days, the following method may be used:

\$1 at interest at 6% will earn

in 1 year								\$0.06.
in 2 months ($\frac{1}{6}$ of a year)				$\frac{1}{6}$ of \$0.06,	or			\$0.01.
in 1 month ($\frac{1}{2}$ of 2 months)				$\frac{1}{2}$ of \$0.01,	or			\$0.005.
in 6 days ($\frac{1}{5}$ of a month)				$\frac{1}{5}$ of \$0.005,	or			\$0.001.
in 1 day ($\frac{1}{6}$ of 6 days)				$\frac{1}{6}$ of \$0.001,	or			\$0.000 $\frac{1}{6}$.

Find how much \$1 will earn at 6% in the following periods of time:

1. Years:	1	3	5	7	2	4	6	8
2. Months:	2	4	6	8	10	1	3	5
3. Months:	7	9	11	12	15	18	20	24
4. Days:	6	12	18	24	3	9	15	21
5. Days:	27	2	4	8	10	14	16	20
6. Days:	22	26	28	5	7	11	13	17
7. Days:	19	23	25	29	36	48	60	90

8. What is the interest on \$1 for 2 years 7 months 17 days at 6%? On \$348?

At 6% the interest on \$1

for 2 years	= \$0.12
for 7 months	= .035
for 17 days	= .002 $\frac{1}{2}$
for 2 years 7 months 17 days	= \$0.157 $\frac{1}{2}$
348 times \$0.157 $\frac{1}{2}$	= ?

How much will \$420 earn at 6% in :

9. 1 yr. 6 mo. ? ~~10~~ 2 yr. 6 mo. ? ~~11~~ 1 yr. 4 mo. ?
~~12~~ 1 yr. 8 mo. ? ~~13~~ 1 yr. 2 mo. ? ~~14~~ 1 yr. 10 mo. ?
~~15~~ 1 yr. 2 mo. 12 da. ? ~~16~~ 1 yr. 7 mo. 11 da. ?
~~17~~ 1 yr. 4 mo. 18 da. ? ~~18~~ 1 yr. 8 mo. 11 da. ?

19. Find the interest on \$342 for 3 months 10 days at 6%.

20. Find the interest and the amount of \$385 for 3 months 20 days at 5%.

Interest of \$1 at 6%

for 3 mo.	= \$0.015
for 20 da.	= .003 $\frac{1}{2}$
for 3 mo. 20 da.	= \$0.018 $\frac{1}{2}$

(385)
 6) \$7.058 $\frac{1}{2}$, interest at 6%
 \$1.176 $\frac{1}{2}$, interest at 1%
 5
 \$5.880, interest at 5%
 385.00 principal
 \$390.88, amount

21. The interest of any principal at 5% is what part of the interest at 6% ?

22. What part of the interest at 6% is the interest at 3% ? 4% ? 2% ? 1% ?

THE BANKERS' METHOD

When the time is given in days, the following method, commonly called the *bankers' method*, may be used.

Since the interest at 6% of any principal for 60 days is .01 of itself, first find the interest for 60 days, and then take such parts of this interest as may be necessary. Thus, in finding the interest at 6% of \$360 for 98 days:

$$98 \text{ days} = 60 \text{ days} + 30 \text{ days} + 5 \text{ days} + 3 \text{ days}$$

$$\underline{\$360 = \text{principal}}$$

$$\$3.60 = \text{interest for 60 days}$$

$$1.80 = \text{interest for 30 days } (\frac{1}{2} \text{ of interest for 60 days})$$

$$.30 = \text{interest for 5 days } (\frac{1}{6} \text{ of interest for 30 days})$$

$$\underline{.18 = \text{interest for 3 days } (\frac{1}{6} \text{ of interest for 30 days})}$$

$$\$5.88 = \text{interest for 98 days}$$

Find the interest at 6% on:

- | | |
|------------------------|-----------------------|
| 1. \$960 for 90 days | 2. \$480 for 36 days |
| X 3. \$840 for 24 days | ④ \$360 for 48 days |
| X 5. \$720 for 84 days | 6. \$240 for 72 days |
| X 7. \$420 for 66 days | 8. \$990 for 40 days |
| X 9. \$540 for 87 days | 10. \$680 for 96 days |

Find the interest:

	PRINCIPAL	RATE	TIME		PRINCIPAL	RATE	TIME
11.	\$640	8%	54 days	12.	\$860	4%	45 days
13.	\$760	5%	27 days	14.	\$790	7%	33 days
15.	\$240	7%	78 days	16.	\$750	5%	42 days
17.	\$675	8%	39 days	18.	\$972	7%	50 days
19.	\$864	4%	56 days	20.	\$246	3%	69 days

PROBLEMS

- X 1. How much will \$450 earn in 1 year 3 months at 5%?

X₂. At 8%, what is the interest on \$570 for 1 year 7 months?

X₃. What is the interest on \$12,000 for 15 days at 4%?

X₄. A man has the use of \$1260 for 3 months 21 days. How much interest must he pay if money is worth 5%?

X₅. What will settle an account of \$642 that has been running 54 days, with interest at 7%?

X₆. What must be paid to settle in full an account of \$945 that has been drawing interest at 5% for 2 months 24 days?

7. How much interest is due Oct. 17 on a note for \$1485, dated June 26, with interest at 5%?

X₈. Mr. Davis borrowed \$387.54 on Nov. 22, 1910, agreeing to pay 7% interest. He settled the account on May 10, 1911. How much did he pay?

X₉. On March 12 Mr. Buxton loaned \$2800 to Mr. Ray at 5%, interest to be paid every 6 months. When is the first payment due? How much must Mr. Ray pay?

X₁₀. How much interest is due Oct. 11, 1911, on a note for \$459 that has been running since Jan. 28, 1911, with interest at 8%?

X₁₁. Mr. Sampson buys a horse for \$156, paying \$40 down and agreeing to pay the balance in 3 months with interest at 5%. How much must he pay at the end of the three months?

X₁₂. \$1740 is borrowed for 20 days at 5%. How much will settle the account at the end of the 20 days?

③ How much is the interest on \$750 for 75 days at 4%?

14. Find the interest on \$1440 for 48 days at 7%.

WRITTEN EXERCISE

Find the interest :

Find the amount :

	PRINCIPAL	RATE	TIME	
			Mo.	Da.
1.	\$ 864	5%	3	17
3.	\$ 432	4%	6	15
5.	\$ 582	6%	5	18
7.	\$ 648	7%	3	11
9.	\$ 750	3%	4	19
11.	\$ 846	4%	2	17
13.	\$ 750	5%	3	27
15.	\$ 354	5%	4	16
17.	\$ 1200	8%	1	20
19.	\$ 672	7%	3	8
21.	\$ 1446	5%	2	9
23.	\$ 2970	4%	5	22
25.	\$ 5652	5%	3	28
27.	\$ 3456	6%	1	19
29.	\$ 1908	5%	2	26
31.	\$ 3642	6%	3	5
33.	\$ 2706	4%	1	7
35.	\$ 6336	7%	2	9
37.	\$ 9264	5%	3	15
39.	\$ 8346	5%	2	27
41.	\$ 7434	4%	5	20
43.	\$ 4194	6%	4	10
45.	\$ 6276	5%	3	29
47.	\$ 2832	3%	1	14

	PRINCIPAL	RATE	TIME
			Da.
* 2.	\$ 240	4%	98
* 4.	\$ 354	5%	48
* 6.	\$ 236	6%	123
* 8.	\$ 360	5%	79
+ 10.	\$ 438	5%	34
+ 12.	\$ 912	3%	92
14.	\$ 930	5%	76
16.	\$ 870	4%	44
18.	\$ 1410	6%	53
20.	\$ 894	5%	100
22.	\$ 6396	8%	144
24.	\$ 2406	5%	108
26.	\$ 1794	7%	80
28.	\$ 5688	6%	90
30.	\$ 3672	5%	64
32.	\$ 1098	5%	29
34.	\$ 2634	4%	37
36.	\$ 4260	7%	43
38.	\$ 7506	4%	65
40.	\$ 3474	5%	53
42.	\$ 5394	7%	68
44.	\$ 6978	5%	60
46.	\$ 4236	5%	90
48.	\$ 1992	4%	75

MISCELLANEOUS PROBLEMS

1. The temperature at noon on Monday was 40° . It rose 8° on Tuesday, fell 17° on Wednesday, rose 3° on Thursday, fell 16° on Friday, and rose 14° on Saturday. What was the temperature on Saturday?

2. At \$9.25 per M, what is the cost of 12,400 bricks?
3. A dealer sells from a roll of ribbon 60 yd. long the following quantities: $.875$ yd., $\frac{1}{4}$ yd., $3\frac{1}{8}$ yd., $2\frac{1}{4}$ yd., $5\frac{1}{2}$ yd., and 8.5 yd. How many yards has he left? What per cent of the original piece?
4. How much carpeting 27 in. wide will be required to carpet a room 15 ft. by $16\frac{1}{2}$ ft., allowing 1 ft. on each strip except the first for matching?
5. A dealer puts up 192 sample packages of tea in $\frac{3}{4}$ -oz. packages. How many pounds of tea did he put up?
6. Mr. Curtis bought $1\frac{1}{2}$ A. of land for \$3000. He cut it up into lots containing 32 sq. rd., each of which he sold for \$800. What was his entire gain?
7. Three pipes can fill a cistern in 12 hr., 15 hr., and 20 hr., respectively. How long will it take to fill the cistern: (a) If the three are used together? (b) If the first and second are used? (c) If the first and third are used? (d) If the second and third are used?
8. At \$1.68 per square yard, how much will it cost to lay a floor in a room $15\frac{1}{2}$ ft. by 12 ft.?
9. How much less would it cost to cover the floor with carpeting worth \$1.35 per yard?
10. A contract for a railroad requires that the rails weigh 70 lb. to the yard. How many tons of rails will lay the road, which is $3\frac{1}{2}$ mi. long?
11. A room 30 ft. long, 24 ft. wide, and 12 ft. high is to be plastered at 35¢ per square yard. There are 4 doors 8 ft. by 4 ft., and 6 windows 9 ft. by $3\frac{3}{4}$ ft. Find the cost, deducting one half of the area of openings.

12. A rug $3\frac{1}{2}$ yd. by $2\frac{1}{2}$ yd. leaves an uncovered space 2 ft. wide all around the room. What is the floor area of the room? How many feet of picture molding must be bought for the room?

13. How many loads of earth were removed in digging a cellar, if the earth removed when spread evenly over a lot 60 ft. by 45 ft. raised the grade 3 in.?

14. $12\frac{1}{4}$ lb. of 60-cent tea were accidentally emptied into a chest containing $7\frac{3}{4}$ lb. of 40-cent tea. What is the mixture worth per pound?

15. How many panes of glass 2 ft. by 2 ft. must a schoolroom have, whose dimensions are 40 ft. by 24 ft., in order that the lighting surface may equal $\frac{1}{5}$ the floor space?

16. A lot of land containing 1 A. is 360 ft. long. From one end is sold a lot 150 ft. long, and from the other end a lot 90 ft. long. What part of an acre is left?

17. A furnace pipe is $2\frac{1}{2}$ ft. long and $22\frac{3}{4}$ in. in circumference. Allowing 1 in. for the seam, what were the dimensions of the piece of sheet iron from which it was made?

18. At $\$1\frac{1}{2}$ per yard, what is the cost of carpeting a room 23 ft. by 19 ft. with carpeting $\frac{3}{4}$ yd. wide?

19. At $\frac{1}{2}\phi$ a square foot for sod, what will it cost to sod a lawn 75 ft. long and 40 ft. wide, if the cost of laying the sod is $\frac{3}{8}\phi$ per square foot?

20. A certain city of 100,000 inhabitants covers an area of $12\frac{1}{2}$ sq. mi. How many people is this to the acre?

21. At 25¢ per cubic yard, find the cost of excavating a cellar 36 ft. long, 22 ft. wide, and 6 ft. deep, and of cementing the bottom at 15¢ per square yard.

22. \$37 is $\frac{1}{4}$ of A's money and $\frac{1}{5}$ of B's money. How much more than A has B?

23. A well 20 ft. deep and 4 ft. in diameter is half full of water. How many gallons?

24. What is the area over which a cow can graze if tethered to a stake by a rope 25 ft. long?

25. A pond 120 ft. in diameter gives what area for skating when frozen over?

26. What is the interest at 5% of \$2400 for 110 da.?

27. What is the gain per cent in buying collars at 75¢ a dozen and selling them at 3 for 25¢?

28. Find the area of a triangle whose base is 4 ft. 3 in. and whose altitude is 40 in.

29. Ed paid \$24.75 for his bicycle and sold it for 32% less. How much did he receive for it?

30. Two farms were sold for \$3000 each. On one 20% was gained, and on the other 20% was lost. Did the owner gain or lose by the transaction? How much?

31. A street $\frac{1}{4}$ mi. long and 3 rd. wide is paved with asphalt. How many square yards of paving?

32. Two trains leave Chicago at 10 o'clock in the morning. One travels east at the rate of 48 mi. an hour; the other travels west at the rate of 42 mi. an hour. How far apart are the trains at 20 min. of 3 in the afternoon?

33. What must a clothing dealer ask for goods which cost him \$8 $\frac{1}{4}$ in order to make a profit of 20%?

34. One pipe discharges $6\frac{3}{4}$ gal. per minute, and another discharges $5\frac{1}{4}$ gal. per minute. How long will it take to empty a tank whose capacity is 600 gal.?

35. If to a disinfecting solution is added 12 parts of water, what fraction represents the strength of the mixture?

36. On a plan drawn on the scale of $\frac{1}{2}$ in. to a foot, what is the area of a lot whose frontage is $33\frac{1}{2}$ in. and whose depth is $48\frac{3}{4}$ in.?

37. 7.7 is the product of four factors, three of which are 1, 3.08, and 2.5. What is the fourth?

38. Which covers the greater space, a tile 6 in. square, or a tile containing 6 sq. in.? How many times the smaller is the larger? What part of the larger is the smaller?

39. Mrs. Hovey bought two remnants of silk; one lacked 9 in. of being 2 yd., and the other 6 in. of being $1\frac{1}{4}$ yd. What was the total number of yards bought?

40. A heating apparatus is warranted to supply 30 cu. ft. of fresh air per minute for every person in the room. If the room is 30 ft. long, 25 ft. wide, and 12 ft. high, and contains 40 persons, how often must the air in the room be renewed?

41. How many 500-lb. bales of cotton can be harvested from a field of $168\frac{3}{4}$ A., if the average yield per acre is 240 lb.?

42. An ice boat sails 18 mi. in 1 hr. 3 min. What is the rate per minute? How long does it take to go a mile?

43. A farmer raised 900 bu. of beans. One dealer offered him $4\frac{1}{2}$ ¢ per pound, and another dealer offered \$2.40 per bushel of 60 lb. Which was the better offer? By how much?

44. From the sum of 64.007 and 3.02 take the difference between 30.04 and .0607.

45. What must be added to the sum of .0105 and .604 to make one whole one?

46. Divide the sum of .03125 and .01875 by their difference.

47. Under a street 1320 ft. long there is laid a telephone cable consisting of 48 wires. How many miles of telephone wire in the cable?

48. Washington was born Feb. 22, 1732. Franklin was born Jan. 17, 1706. How old was Franklin when Washington was born?

49. When steel rails are manufactured for \$13.50 per ton, and sold for \$28 per ton, a profit of \$26,100 on one sale represents the sale of how many tons?

50. A block of stone 4 ft. \times 3 ft. \times 5 ft. is used as a watering trough. A place 2 ft. 6 in. long, 1 ft. 8 in. wide, and 1 ft. deep is hollowed out of the top. How many cubic feet of stone in the trough? How many gallons of water will the top hold?

51. A quart of floor varnish will cover a space of 150 sq. ft. How much will it cost at \$2.80 per gallon to varnish two floors whose dimensions are 18 ft. by 15 ft., and 15 ft. by 12 ft.?

52. A reservoir is 60 ft. 8 in. long and 48 ft. 4 in. wide. To make some repairs it is necessary to lower the water 15 in. How many cubic feet must be drawn off?

53. Wishing to measure a field, a boy used a pole which he supposed to be 10 ft. in length. He found the field to be 180 ft. by 90 ft. He afterwards found his measure to be 9 ft. long. What were the real dimensions of the field?

54. How many dress patterns of $12\frac{3}{4}$ yd. each can be cut from a piece of goods containing 85 yd.? What will be the length of the remnant?

55. By what must you multiply the sum of 40.4 and 4.04 to get 4444?

56. What is the capacity in gallons of a tank 24 in. long, 11 in. wide, and 14 in. deep?

57. On a certain day the sun shone from 9:45 to 11:30 A.M., from 1:20 to 2, and from 2:50 to 3:25 P.M. What part of the 24 hours did the sun shine?

58. At $16\frac{1}{3}$ ¢ per square yard, what will it cost to paint a kitchen floor 15 ft. 9 in. long and 12 ft. wide?

59. When a dealer buys 28 bu. of peas at \$1.20 per bushel and 8 bu. are found to be worthless, for what must he sell the remainder per peck to get his money back?

60. By selling a shopworn book for \$1.20 a dealer sacrifices 75%. What was the cost?

61. By what must you divide the difference between .015 and .15 to get 13.5 for a quotient?

62. How many paving stones 8 in. square will be required to pave a street 20 rd. long and 60 ft. wide?

PART III

ADVANCED ARITHMETIC

NOTATION AND NUMERATION

Hundred-millions	Ten-millions	Millions	Hundred-thousands	Ten-thousands	Thousands	Hundreds	Tens	Units	Tenths	Hundredths	Thousandths	Ten-thousandths	Hundred-thousandths	Millionths
					6	7	0	5	.					
									0	1	8			
6	0	7	5	9	3	7	6	0	.	0	2	4	7	
			9	0	0	0	8	3	.					
						3	0	0	.	0	0	0	0	5
			8	0	7	0	2	9	.	0	0	7	0	6
														2

1. Read aloud each of the above numbers, then write each in words.

2. Find the sum of the above numbers, and write the answer in words.

The next group beyond millions is the billions' group.

3. Read 8764321427.

Separating into groups, we have 8,764,321,427. We read, eight billion seven hundred sixty-four million three hundred twenty-one thousand four hundred twenty-seven.

Separate into groups, read aloud, and then write in words:

- | | | |
|---------------|----------------|-----------------|
| 4. 3762425100 | 5. 15493762449 | 6. 156437289452 |
| 7. 9037008643 | 8. 96007625800 | 9. 873600708509 |

Write in figures :

1. Three billion two hundred seventeen million four hundred sixty-four thousand nine hundred seventy-six.
2. Four billion six hundred million forty thousand three hundred.
3. Sixty-seven billion eight hundred thirty-two thousand ninety.
4. One hundred eighty billion two hundred sixty million.
5. Seven hundred ninety-five billion two hundred eighty-four thousand.

Read :

1. At one time there were in the state of New York 137 savings banks with 2,760,343 depositors, having total deposits of \$1,405,239,941.56.
2. In the year 1909 there were imported into the United States 4,084,921,078 pounds of sugar valued at \$96,554,998.
3. The total income of all the railroads in the United States in one year was \$2,393,805,989, and the total expense of operating was \$1,699,547,896.

NOTE. Practice in reading and writing numbers should be given frequently.

ROMAN NOTATION AND NUMERATION

1. Name the seven letters used in Roman notation, and tell the value assigned to each.

Write in figures:

2. XLIX 3. LXXVII 4. XCIV 5. \overline{C}

6. MCMXV 7. MDCCLXXIX 8. MCCCCXCII

9. Write in Roman notation the proper headings for these chapters of a book: 29th; 37th; 42d; 51st.

10. Write in Roman notation these years: 1600; 1066; 1776; 1800; 1915; 1920.

FUNDAMENTAL PROCESSES

Solve by groups:

I	II	III
1. 23479	1. \$178.52	1. 321.17
68521	464.29	6.042
682	317.56	8.137
12038	302.27	92.106
4297	438.95	8.07
54925	527.98	13.009
76	607.72	.08
93625	321.56	24.7
7624	49.16	3.943
2. 39,204 - 18,762	2. \$824.19 - \$367.40	2. 64.08 - 29.173
3. 3765 \times 237	3. \$238.96 \times 87	3. 6.82 \times 2.07
4. 164,329 \div 124	4. \$402.40 \div 56	4. 1.776 \div 4.8

NOTE. Drill on exercises like the above should be given frequently with a time limit for each example.

WRITTEN PROBLEMS

SCORES IN A CANDLE PIN BOWLING MATCH

TIGERS				PANTHERS			
Bowlers	First String	Second String	Third String	Bowlers	First String	Second String	Third String
Gibson	87	94	86	Gates	87	92	85
Bruce	94	100	91	Coburn	91	89	105
Kennedy	109	92	111	Ferguson	90	82	83
Moran	95	80	101	Abbott	111	104	97
Mahoney	112	118	91	Gardner	87	96	90

1. Which team won? By how many points?
2. Find the average pinfall per string of each bowler of the Tigers. Of the whole team. Of each bowler of the Panthers. Of the whole team.
3. The heaviest freight locomotive and tender ever built weigh 700,000 pounds. The tender weighs 237,550 pounds. Find the weight of the locomotive.
4. By selling 60 yards of silk for \$87, a merchant made \$25.20. What was the cost per yard?
5. A mason's charges for putting on new ceilings and repairing walls in two rooms were: J. Collins, $21\frac{1}{2}$ hours' labor @ \$0.55; M. Corcoran, 15 hours @ \$0.55; A. Gove, 11 hours @ \$0.35; P. McKenzie, 8 hours @ \$0.35; $6\frac{1}{2}$ barrels mortar @ \$1.50; 3 barrels skimming @ \$1.50; 1 pail calcine plaster, \$0.25; teaming, \$2. Find the total.
6. If from a piece of land containing 43,560 square feet there are sold two lots of 8926 square feet each, and 687 square feet are given for a road, how many square feet are left?

7. A grocer buys 6 56-pound tubs of butter at $28\frac{1}{4}$ cents a pound, and 8 36-pound tubs at $32\frac{3}{4}$ cents a pound. How much will he make by selling the whole at 36 cents a pound?

8. A wholesale grocer paid \$28 for 320 lb. of first-quality prunes, and \$33 for 600 lb. of second-quality. He then mixed them, and sold them for 8 cents per pound. What was his gain?

9. A 64-year-old stand of 198 black walnut trees in Illinois yielded 42,000 board feet of lumber, 1800 fence posts, and 15 cords of firewood. The lumber was sold at \$20 per M, the fence posts at \$12.50 per C, and the firewood at \$2 per cord. Find the total receipts. Find the average number of board feet of lumber from each tree.

10. The annual report of a railroad corporation reads as follows: Income: from operation, \$12,651,977; from rental of property, \$345,849. Disbursements: operating expenses, \$5,249,274; interest and taxes, \$2,844,564; dividends, \$3,864,000. Find the total income; the total disbursements; the surplus, that is, the excess of income over disbursements.

11. The receipts of the U. S. government for the year ending June 30, 1910, were: customs, \$333,683,445; internal revenue, \$289,933,519; all other sources, \$51,894,751. The expenditures were: civil and miscellaneous items, \$180,076,442; war department, \$155,911,706; navy department, \$123,173,717; Indians, \$18,504,131; pensions, \$160,696,416; interest on public debt, \$21,342,979. Find the total receipts; the total expenditures; the excess of receipts over expenditures.

DICTATION EXERCISES

1. $56 + 8, \times 5, + 7, + 3, - 5, + 3, \times 7, + 6, \div 9, - 2$
2. $6 + 0, \times 12, + 3, + 5, - 7, \times 7, - 2, + 9, - 6$.
3. $8 \times 4, \times 2, + 4, + 8, + 6, + 5, \times 7, + 3, + 7, \div 4$.
4. $12^2, + 6, + 5, + 2, + 4, + 9, - 5, \times 9, - 8, + 20, - 2$.
5. $24 - 6, \times 2, + 4, + 3, \times 9, - 1, + 4, + 5, \times 4, - 1$.

POSTAL MONEY ORDERS

At any post office in the United States a money order may be obtained directing the postmaster at another office to pay a specified sum of money to a specified person.

FEES FOR MONEY ORDERS DRAWN ON DOMESTIC FORM

Payable in the United States (which includes Hawaii and Porto Rico) and its possessions comprising the Canal Zone (Isthmus of Panama), Guam, the Philippines and Tutuila, Samoa; also for Orders payable in Bermuda, British Guiana, British Honduras, Canada, Cuba, Newfoundland, the United States Postal Agency at Shanghai (China), the Bahama Islands, and certain other Islands in the West Indies mentioned in Register of Money Order Post Offices

For Orders From \$ 0.01 to \$ 2.50	..... 3 cents.
From \$ 2.51 to \$ 5.00	..... 5 cents.
From \$ 5.01 to \$ 10.00	..... 8 cents.
From \$ 10.01 to \$ 20.00	..... 10 cents.
From \$ 20.01 to \$ 30.00	..... 12 cents.
From \$ 30.01 to \$ 40.00	..... 15 cents.
From \$ 40.01 to \$ 50.00	..... 18 cents.
From \$ 50.01 to \$ 60.00	..... 20 cents.
From \$ 60.01 to \$ 75.00	..... 25 cents.
From \$ 75.01 to \$ 100.00	..... 30 cents.

NOTE. The maximum amount for which a single Money Order may be issued is \$100. When a larger sum is to be sent, additional Orders must be obtained.

1. You wish to send a money order for \$6.75 to the Farmers' Seed Company, 1024 State St., St. Louis, Mo. Tell what must be written in each blank space in the following :

APPLICATION FOR DOMESTIC MONEY ORDER

Spaces below to be filled in by purchaser, or, if necessary,
by another person for him

Amount

----- 25 ----- Dollars 60 Cents

Pay to
Order of }

(Name of person or firm for whom order is intended)

Whose
Address
is }

No. ----- Street

Post
Office }

State -----

Sent by -----

(Name of Sender)

Address
of
Sender }

No. ----- Street

PURCHASER MUST SEND ORDER (ON BLUE PAPER) TO PAYEE

2. How much must be paid to the postmaster in addition to the amount you wish to send to the seed company?

3. On receiving the money and fee, the postmaster issues a money order, which you mail to the seed company. To whom will the company present the order for payment? What amount will be paid?

4. Make out an application for a money order you require to pay \$17.87 to Pratt, Parker & Co., 1287 Union St., Rochester, N. Y. What is the cost of the order?

5. What is the cost of a money order for \$2.90?
\$2.49? \$2.52? \$8.73? \$10.25?

6. Mr. Ashton bought five money orders for these amounts: \$2.50, \$3.27, \$15.46, \$28.75, and \$30. Find the total cost.

7. Susan McDonald sends a money order to pay for 3 books at \$1.67 each. Find the cost.

8. Find the cost of a money order to pay for 1½ dozen pairs of stockings at \$¼ per pair.

9. Mr. Graham sends to his son who is away at school a money order to cover 9 weeks' board at \$4.50 a week, tuition fee of \$45, and other expenses amounting to \$17. Find the cost of the order.

10. A gymnasium class bought 3 dozen pairs of dumbbells at 40 cents a pair, 5% discount. Find the cost of the money order and postage.

11. Seven people form a magazine club, taking 3 magazines at \$1.35 each, 2 at \$3.35 each, 1 at \$2.65, and 1 at 90 cents. Find the cost of money order and postage. How much does each person pay?

REVIEW OF FRACTIONS

Oral

1. What is an integer? A fraction?

2. What does the denominator of a fraction tell? The numerator?

3. What is a proper fraction? An improper fraction? A mixed number?

4. Change to 54ths: $\frac{7}{27}$ $\frac{17}{18}$ $\frac{5}{9}$ $\frac{5}{6}$ $\frac{3}{2}$ $\frac{1}{2}$

5. Change to 56ths: $\frac{19}{28}$ $\frac{11}{14}$ $\frac{5}{8}$ $\frac{4}{7}$ $\frac{3}{4}$ $\frac{1}{2}$

6. Change to 8ths: $\frac{21}{24}$ $\frac{13}{32}$ $\frac{25}{40}$ $\frac{21}{56}$ $\frac{27}{72}$ $\frac{69}{96}$

7. Change to 12ths: $\frac{10}{24}$ $\frac{25}{60}$ $\frac{30}{72}$ $\frac{88}{96}$ $\frac{63}{108}$ $\frac{84}{144}$

8. Change to mixed numbers :

$$\frac{85}{7}, \frac{57}{8}, \frac{52}{9}, \frac{105}{12}, \frac{108}{15}, \frac{181}{20}$$

9. Change to improper fractions :

$$8\frac{5}{9}, 12\frac{5}{8}, 10\frac{1}{10}, 15\frac{2}{8}, 9\frac{1}{20}, 10\frac{2}{4}$$

10. When is a fraction in its lowest terms?

WRITTEN EXERCISES

Change to lowest terms :

1. $\frac{188}{880}$	2. $\frac{388}{880}$	3. $\frac{284}{880}$	4. $\frac{121}{871}$	5. $\frac{165}{255}$
6. $\frac{482}{578}$	7. $\frac{308}{838}$	8. $\frac{380}{585}$	9. $\frac{385}{885}$	10. $\frac{287}{495}$
11. $\frac{612}{1530}$	12. $\frac{363}{1331}$	13. $\frac{875}{2000}$	14. $\frac{576}{1728}$	15. $\frac{108}{1728}$
16. $\frac{625}{5625}$	17. $\frac{1470}{3500}$	18. $\frac{1400}{2240}$	19. $\frac{1152}{3456}$	20. $\frac{4875}{5280}$

Change to improper fractions :

1. $15\frac{5}{8}$	2. $13\frac{5}{8}$	3. $26\frac{7}{11}$	4. $19\frac{15}{18}$	5. $18\frac{2}{14}$
6. $28\frac{7}{15}$	7. $32\frac{17}{24}$	8. $36\frac{14}{25}$	9. $33\frac{12}{38}$	10. $54\frac{12}{37}$
11. $48\frac{18}{19}$	12. $67\frac{16}{35}$	13. $39\frac{18}{40}$	14. $47\frac{18}{48}$	15. $65\frac{37}{52}$
16. $84\frac{57}{84}$	17. $78\frac{38}{48}$	18. $75\frac{52}{85}$	19. $93\frac{67}{88}$	20. $87\frac{84}{85}$

Change to mixed numbers :

1. $\frac{127}{19}$	2. $\frac{253}{24}$	3. $\frac{243}{18}$	4. $\frac{267}{15}$	5. $\frac{295}{30}$
6. $\frac{347}{36}$	7. $\frac{453}{42}$	8. $\frac{562}{45}$	9. $\frac{873}{48}$	10. $\frac{951}{52}$
11. $\frac{1082}{66}$	12. $\frac{1532}{67}$	13. $\frac{1627}{75}$	14. $\frac{1728}{84}$	15. $\frac{2000}{82}$
16. $\frac{2240}{85}$	17. $\frac{3225}{88}$	18. $\frac{7500}{91}$	19. $\frac{8692}{95}$	20. $\frac{2075}{98}$

SIGHT EXERCISES

2	3	4	5	6	7	8	9	10
$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{5}$	$\frac{1}{6}$	$\frac{1}{7}$	$\frac{1}{8}$	$\frac{1}{9}$	$\frac{1}{10}$

1. What must be taken from each number in the first row to leave the number directly under it in the second row?

2. Multiply each number in the first row by each fraction in the second row.

3. Divide each fraction in the second row by each number in the first row; each number in the first row by each fraction in the second row.

4. To each fraction in the second row add $\frac{1}{2}$; $\frac{1}{3}$; $\frac{1}{4}$; etc., to $\frac{1}{10}$.

5. Find the difference between each fraction and $\frac{1}{2}$; $\frac{1}{3}$; $\frac{1}{4}$; etc., to $\frac{1}{10}$.

6. Multiply each fraction by $\frac{1}{2}$; $\frac{1}{3}$; $\frac{1}{4}$; etc., to $\frac{1}{10}$.

7. Divide each fraction by $\frac{1}{2}$; $\frac{1}{3}$; $\frac{1}{4}$; etc., to $\frac{1}{10}$.

NOTE. The above work may be extended indefinitely by using $\frac{1}{11}$; $\frac{1}{12}$; etc.

SIGHT EXERCISE

	A	B	C	D	E
1.	$\frac{2}{4}$	$\frac{1}{2}$	$\frac{2}{6}$	$\frac{1}{3}$	$\frac{6}{7}$
2.	$\frac{5}{8}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{2}{3}$
3.	$\frac{5}{6}$	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{7}{9}$	$\frac{7}{10}$
4.	$\frac{4}{5}$	$\frac{2}{3}$	$\frac{3}{7}$	$\frac{3}{4}$	$\frac{3}{4}$
5.	$\frac{3}{4}$	$\frac{3}{10}$	$\frac{3}{5}$	$\frac{7}{8}$	$\frac{8}{9}$
6.	$\frac{7}{10}$	$\frac{2}{5}$	$\frac{5}{6}$	$\frac{4}{5}$	$\frac{5}{6}$
7.	$\frac{5}{7}$	$\frac{5}{8}$	$\frac{3}{7}$	$\frac{1}{8}$	$\frac{5}{8}$

Find the sum of each couplet; the difference; the product; the quotient of the first term divided by the second.

Add at sight:

$$\begin{array}{r} 1. \quad \frac{1}{2} \\ \frac{1}{4} \\ \frac{3}{8} \\ \frac{3}{4} \\ \hline 1\frac{7}{8} \end{array}$$

$$\begin{array}{r} 2. \quad \frac{1}{3} \\ \frac{5}{6} \\ \frac{1}{2} \\ \frac{2}{3} \\ \hline 2\frac{9}{12} \end{array}$$

$$\begin{array}{r} 3. \quad \frac{1}{2} \\ \frac{1}{3} \\ \frac{5}{12} \\ \frac{1}{6} \\ \hline 2\frac{1}{2} \end{array}$$

$$\begin{array}{r} 4. \quad \frac{1}{5} \\ \frac{1}{2} \\ \frac{7}{10} \\ \frac{4}{5} \\ \hline 2\frac{5}{10} \end{array}$$

$$\begin{array}{r} 5. \quad \frac{1}{2} \\ \frac{1}{4} \\ \frac{5}{8} \\ \frac{1}{2} \\ \hline 1\frac{7}{8} \end{array}$$

6. $8\frac{1}{8}$	7. $6\frac{4}{5}$	8. $7\frac{3}{4}$	9. $9\frac{5}{12}$	10. $7\frac{5}{8}$
$2\frac{2}{3}$	$2\frac{1}{10}$	$2\frac{3}{10}$	$5\frac{1}{4}$	$4\frac{1}{2}$
$7\frac{1}{2}$	$3\frac{3}{20}$	$4\frac{1}{5}$	$1\frac{1}{8}$	$5\frac{3}{8}$
$4\frac{1}{8}$	$5\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{1}{8}$	$9\frac{1}{8}$

Subtract at sight:

1. $9\frac{5}{4}$	2. $8\frac{3}{8}$	3. $7\frac{3}{4}$	4. $6\frac{3}{8}$	5. $4\frac{1}{8}$
$2\frac{1}{2}$	$3\frac{1}{2}$	$5\frac{5}{8}$	$3\frac{7}{10}$	$2\frac{5}{12}$
6. $7\frac{1}{2}$	7. $6\frac{2}{3}$	8. $3\frac{1}{12}$	9. $9\frac{2}{3}$	10. $4\frac{2}{30}$
$2\frac{5}{8}$	$4\frac{3}{8}$	$1\frac{1}{4}$	$6\frac{7}{12}$	$1\frac{1}{5}$
$4\frac{1}{2}$				

WRITTEN EXERCISES

Solve:

A	B	C	D
1. $13\frac{1}{8} + 15\frac{5}{8}$	$27\frac{11}{12} - 14\frac{7}{8}$	$\frac{7}{8} \times 36$	$20 \div 4\frac{4}{5}$
2. $65\frac{1}{5} + 43\frac{4}{5}$	$52\frac{8}{11} - 19\frac{7}{9}$	$35 \times \frac{8}{15}$	$\frac{6}{7} \div \frac{3}{5}$
3. $36\frac{7}{12} + 29\frac{11}{12}$	$64\frac{7}{12} - 25\frac{13}{12}$	$\frac{5}{12} \times \frac{3}{16}$	$73\frac{3}{8} + 11$
4. $28\frac{3}{8} + 42\frac{5}{8}$	$35\frac{9}{4} - 26\frac{17}{8}$	$7\frac{5}{8} \times 54$	$19\frac{5}{8} \div 30\frac{1}{8}$
5. $37\frac{13}{18} + 72\frac{2}{3}$	$47\frac{13}{18} - 32\frac{8}{27}$	$56 \times 18\frac{3}{4}$	$144 \div 4\frac{1}{18}$
6. $51\frac{8}{15} + 26\frac{7}{15}$	$59\frac{13}{18} - 17\frac{11}{18}$	$30\frac{5}{8} \times 25\frac{3}{8}$	$116\frac{4}{9} \div 9$
7. $75\frac{3}{8} + 48\frac{7}{8}$	$67\frac{17}{27} - 41\frac{11}{27}$	$42\frac{11}{12} \times 18\frac{3}{4}$	$136\frac{3}{7} + 12$
8. $66\frac{13}{18} + 25\frac{5}{2}$	$87\frac{15}{18} - 54\frac{11}{18}$	$\frac{96}{165} \times \frac{1}{16}$	$52\frac{1}{5} + 26\frac{2}{5}$
9. $54\frac{17}{28} + 73\frac{13}{28}$	$73\frac{19}{28} - 42\frac{17}{28}$	$\frac{31}{45} \times \frac{1}{21}$	$165 \div 14\frac{1}{7}$
10. $92\frac{11}{15} + 47\frac{22}{15}$	$95\frac{23}{36} - 51\frac{17}{24}$	$9\frac{7}{12} \times 180$	$192\frac{3}{7} \div 15$
11. $84\frac{33}{48} + 143\frac{11}{48}$	$198\frac{13}{24} - 74\frac{11}{24}$	$125 \times 32\frac{3}{25}$	$49\frac{5}{7} \div 21\frac{3}{7}$
12. $135\frac{21}{40} + 97\frac{9}{40}$	$103\frac{13}{40} - 94\frac{13}{40}$	$\frac{124}{215} \times \frac{5}{8}$	$14\frac{8}{15} \div 9\frac{1}{15}$

Simplify :

1. $\frac{3}{8} \times \frac{20}{21} \times \frac{35}{8}$
2. $\frac{4}{5} \times \frac{55}{8} \times \frac{15}{8}$
3. $\frac{3}{8} \times 6\frac{1}{4} \times 9\frac{3}{8}$
4. $6 \times \frac{7}{8} \times 1\frac{1}{4}$
5. $1\frac{3}{8} \times 2\frac{2}{5} \times 4\frac{1}{6}$
6. $\frac{5}{11} \times 10 \times 66\frac{2}{3}$
7. $\frac{2}{3}$ of $1\frac{3}{8}$ of $4\frac{1}{2}$ of $\frac{1}{2}$
8. $\frac{5}{12}$ of $66\frac{2}{3}$ of $2\frac{2}{3}$ of 5
9. $3\frac{3}{4}$ of $\frac{7}{11}$ of $1\frac{1}{8}$ of $4\frac{1}{2}$
10. $\frac{2}{18}$ of $9\frac{3}{4}$ of $6\frac{2}{3}$ of 8
11. $\frac{81}{3\frac{3}{4}}$
12. $\frac{6\frac{2}{3}}{2\frac{3}{8}}$
13. $\frac{6\frac{2}{3}}{2\frac{1}{2}}$
14. $\frac{36}{5\frac{1}{8}}$
15. $\frac{5\frac{2}{5}}{18}$
16. $\frac{\frac{8}{15}}{\frac{33}{50}}$
17. $\frac{5\frac{5}{6}}{2\frac{1}{10}}$
18. $\frac{22\frac{2}{3}}{66\frac{2}{3}}$
19. $\frac{33\frac{1}{3}}{83\frac{1}{3}}$
20. $\frac{37\frac{1}{2}}{83\frac{1}{3}}$
21. $\frac{\frac{2}{3} + \frac{3}{4}}{\frac{5}{8}}$
22. $\frac{\frac{5}{9} \times \frac{4}{7}}{\frac{1}{2} \text{ of } \frac{2}{3}}$
23. $\frac{\frac{3}{4} \text{ of } \frac{20}{7}}{\frac{5}{8} \text{ of } 1\frac{3}{8}}$
24. $\frac{2\frac{7}{8} - 1\frac{1}{5}}{2\frac{1}{5} \div 1\frac{1}{5}}$
25. $\frac{2\frac{2}{3} + 4\frac{5}{6}}{3\frac{1}{8} - 2\frac{1}{7}}$
26. $\frac{3\frac{3}{8} \times 2\frac{4}{7}}{3\frac{1}{8} - 2\frac{3}{8}}$
27. $\frac{3\frac{1}{2} + 2\frac{1}{5}}{3\frac{1}{2} - 2\frac{1}{5}}$
28. $\frac{8\frac{2}{5} - 2\frac{7}{10}}{11\frac{3}{4} \times 1\frac{5}{16}}$
29. $(\frac{4}{5} \div \frac{2}{5}) + (\frac{2}{3} \times \frac{9}{10})$
30. $(1\frac{1}{2} - \frac{3}{4}) \div (2\frac{1}{8} - 1\frac{3}{4})$
31. $(\frac{2}{7} \div \frac{3}{8}) \div (\frac{5}{8} \times \frac{3}{8})$
32. $(3\frac{3}{8} \times 1\frac{7}{8}) \div (6\frac{2}{3} \div 6\frac{2}{3})$
33. $(6\frac{2}{5} \div 2\frac{2}{5}) - (1\frac{1}{2} \div \frac{3}{4})$
34. $(6\frac{2}{3} \times 7\frac{5}{7}) - (1\frac{4}{5} \times 3\frac{1}{4})$
35. $(3\frac{3}{8} + 2\frac{1}{4}) \div (4\frac{2}{5} \times 1\frac{1}{9})$
36. $(1\frac{2}{3} + 3\frac{1}{2}) \times (2\frac{2}{5} - 1\frac{1}{4})$

SIGHT EXERCISE

Solve by rows:

- | | | |
|---------------------------------------|-----------------------------------|--|
| 1. $\frac{2}{3}$ of 12 is <u>8</u> | 12 is $\frac{2}{3}$ of <u>18</u> | 12 is what part of 30? <u>$\frac{2}{5}$</u> |
| 2. $\frac{3}{8}$ of 24 is <u>9</u> | 24 is $\frac{3}{8}$ of <u>64</u> | 24 is what part of 40? <u>$\frac{3}{5}$</u> |
| 3. $\frac{7}{9}$ of 18 is <u>14</u> | 18 is $\frac{7}{9}$ of <u>27</u> | 18 is what part of 12? <u>$\frac{2}{3}$</u> |
| 4. $\frac{7}{8}$ of 56 is <u>49</u> | 56 is $\frac{7}{8}$ of <u>64</u> | 56 is what part of 40? <u>$\frac{7}{5}$</u> |
| 5. $\frac{7}{4}$ of 28 is <u>49</u> | 28 is $\frac{7}{4}$ of <u>16</u> | 28 is what part of 42? <u>$\frac{2}{3}$</u> |
| 6. $\frac{3}{4}$ of 36 is <u>27</u> | 36 is $\frac{3}{4}$ of <u>48</u> | 36 is what part of 36? <u>1</u> |
| 7. $\frac{5}{9}$ of 45 is <u>25</u> | 45 is $\frac{5}{9}$ of <u>81</u> | 45 is what part of 80? <u>$\frac{9}{8}$</u> |
| 8. $1\frac{2}{7}$ of 84 is <u>100</u> | 84 is $1\frac{2}{7}$ of <u>56</u> | 84 is what part of 72? <u>$\frac{7}{6}$</u> |
| 9. $\frac{5}{7}$ of 35 is <u>25</u> | 35 is $\frac{5}{7}$ of <u>49</u> | 35 is what part of 40? <u>$\frac{7}{8}$</u> |
| 10. $\frac{7}{6}$ of 42 is <u>49</u> | 42 is $\frac{7}{6}$ of <u>36</u> | 42 is what part of 28? <u>$\frac{3}{2}$</u> |

ORAL PROBLEMS

1. Mr. Emery has a 20-acre pasture and a wood lot $\frac{1}{2}$ as large. How many acres in both? 86 ACRES

2. Mr. Davis bought a harrow for \$7.20 and a cultivator for $\frac{2}{3}$ as much. How much for the cultivator? \$16.40

3. Mr. Allen has 84 sheep. This is $\frac{7}{12}$ of the number that Mr. Blake has. How many has Mr. Blake? 144 SHEEP

4. Mr. Chase raised 56 tons of sugar beets and sold 42 tons at one time and the rest at another. What part of his crop did he sell at each time? $\frac{3}{4}$

5. A man owning $\frac{1}{2}$ of a ship sold $\frac{1}{4}$ of his share. What part of the ship did he sell? What part did he still own?

6. The Jackson basket ball team won 35 out of 56 games. What part did it win? $\frac{5}{8}$ Games

7. The Adams bowling team won 36 games and lost 18 games. What part of the games played did it win? $\frac{2}{3}$

8. David paid 60 cents for a knife, which he sold for $\frac{2}{3}$ its cost. How much did he receive for it? 72

9. Mr. French bought a reaper for \$60. This was $2\frac{2}{3}$, or $1\frac{2}{3}$ times as much as he paid for a plow. How much for the plow? \$25

10. By selling a field for \$560, Mr. Grant received $\frac{1}{4}$ more than the cost. Find the cost. \$420

11. Mr. Hopkins asked \$63 for a lot of squash, but sold it for $\frac{1}{3}$ less. How much did he receive?

12. Mr. Jenkins sold his horse for $\frac{3}{4}$ more than he paid. He received \$175. Find the cost.

13. One third of John's money is equal to $\frac{1}{2}$ of Henry's money. John has 36 cents. How much has Henry?

WRITTEN PROBLEMS

1. A man has $4\frac{2}{5}$ dollars. (a) If he gives $\frac{2}{5}$ to charity, how much will he have left? (b) If he gives $\$ \frac{2}{5}$, how much will he have left? (c) Among how many persons can he distribute the money, giving $\$ \frac{2}{5}$ to each person? (d) If this money is $\frac{2}{5}$ of the cost of a suit of clothes, how much is the suit worth?

2. A man left $\frac{1}{2}$ of his estate to his wife, $\frac{1}{4}$ to his daughter, $\frac{1}{8}$ to his son, and the rest to a hospital. What part to the hospital?

3. In one month a business man received 48 telephone calls from out of town and 592 in town. The out-of-town calls were what part of the total number?

4. Mr. Joslin has four fields whose areas are $4\frac{2}{3}$ A., $4\frac{1}{3}$ A., $4\frac{2}{5}$ A., and $4\frac{4}{5}$ A., respectively. Which field is the largest? The smallest? Find the area of all.

5. Mr. Jackson bought 200 feet of lumber at $3\frac{3}{4}$ cents per foot, and 800 feet at $2\frac{3}{5}$ cents per foot. How much did he pay for the whole?

6. How deep in the ground is a flagstaff set if $\frac{1}{3}$ of the total length of 65 feet is above ground?

7. At $\$ \frac{2}{5}$ per square foot, what is the value of a box of window glass of 24 lights, each light containing $5\frac{1}{2}$ square feet?

8. What must be added to $3\frac{1}{8} + 2\frac{2}{5}$ to make $16\frac{7}{8}$?

9. Mr. Field's gas bill in a month when he burned 2400 cubic feet was $\$ 2\frac{4}{5}$. Find the rate per 100 cubic feet.

10. What is the profit on $3\frac{3}{4}$ dozen baskets of plums bought at $\$ \frac{1}{4}$ and sold at $\$ \frac{2}{5}$ a basket?

11. A buys of B 256 lb. of beef @ $8\frac{3}{4}\text{¢}$. B buys of A a barrel of flour for \$7.50, and 360 lb. of sugar @ $5\frac{3}{8}\text{¢}$. How much money is necessary to settle accounts, and who must pay it?

12. It takes 15 yards of cloth $\frac{3}{4}$ of a yard wide to make a dress. How many yards if the cloth is $1\frac{1}{4}$ yards wide?

13. What is the waste in cutting a board 14 ft. long to fill in 3 spaces each $4\frac{5}{12}$ ft. long?

14. The product of three numbers is $157\frac{1}{2}$. Two of the numbers are $6\frac{2}{3}$ and $6\frac{2}{11}$. What is the third?

15. A dealer puts up ammonia for household use by adding 9 parts of water to one of pure ammonia. How much pure ammonia in 25 quarts of the solution?

16. How much ought a merchant to ask for goods costing $\$2\frac{3}{10}$ a yard to gain $\frac{1}{4}$ of the cost? To gain $\$1$?

17. At $\$8\frac{3}{4}$ per M, what is the cost of 23,000 bricks?

18. At the rate of $2\frac{7}{10}$ thousand per day for each mason, how long will it take 8 masons to lay 820,800 bricks?

19. A merchant sold $15\frac{3}{4}$ yd. of dress goods at 48¢ a yard. Two ninths of the amount received was profit. What was the profit?

20. Two boys made a gallon of lemonade, using 16 lemons at 30 cents a dozen and 2 pounds of sugar at 6 cents a pound. They sold it at 5 cents a glass, 6 glasses to a quart. How much was each boy's share of the gain?

21. Standard silver is 9 parts pure silver and 1 part pure copper. (a) How many ounces of pure silver in a quantity of standard silver weighing 80 ounces? (b) How

many ounces of pure copper must be added to 90 ounces of pure silver to make an alloy of standard silver?

22. Fill out the following pay roll of one room in the Union Shoe Shop:

NAMES	M.	TUES.	WED.	THURS.	FRI.	SAT.	TOTAL HOURS	PAY PER HOUR	AMOUNT
Baker, C. H.	8	7	7½	8	6½	4		40¢	\$
Carter, A. T.	6	7½	7½	5½	8	3½		35¢	
Davis, O. R.	7½	5½	8	6½	5	4		32¢	
Fish, M. T.	6½	7½	7½	8	7½	3		30¢	
Goss, C. P.	7	8	6½	5½	7	2½		28¢	
Lane, R. G.	7½	6½	8	7	6½	2½		27¢	
Moran, D. M.	5½	7½	4½	6½	7½	3½		25¢	
Parks, S. L.	6	5½	7	6	5½	2½		24¢	
Toy, J. R.	8	7	6½	7½	6½	4		22¢	
Walsh, M. T.	7½	6½	5	8	7	3½		20¢	
Total, \$									

23. The following statement shows the time in which two men can each do pieces of work in a machine shop. Find the time in which the men together can do each piece of work.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. H. Smith	1 da.	½ da.	1 da.	2 da.	6 da.	2½ da.	3½ da.
M. T. Jones	1 da.	½ da.	½ da.	4 da.	10 da.	3½ da.	4½ da.

24. An oil tank can be emptied by two pipes in 8 minutes. If the larger pipe alone is used, it takes 12 minutes. How long will it take the smaller one alone?

25. The selling price of a lot of land was \$440. This was $\frac{2}{3}$ more than it cost. What was the cost?

26. A series of three readings was given to raise funds for a summer playground. The price of tickets for the

series was \$1 for general admission, and $\frac{1}{2}$ more for reserved seats. Seven hundred twenty tickets were sold, $\frac{5}{12}$ of them for reserved seats. The rent of the hall was \$25 a reading, \$10 was paid for printing and advertising, and the reader received $\frac{2}{5}$ of the net receipts. How much was realized for the playground?

27. Mr. Allen made a business trip to a city 297 miles from his home, paying as follows: 88 miles on a mileage ticket at the rate of 2 cents a mile, 128 miles on a regular ticket at $2\frac{1}{2}$ cents a mile, and the remaining distance for \$2.34. What was the total expense for the round trip?

28. A week later Mr. Allen traveled over the same route on a special round-trip ticket at the rate of $1\frac{3}{4}$ cents a mile. This was how much less than the expense of the trip in example 27?

29. A merchant buys 7 dozen dolls at \$9 a dozen. If $\frac{1}{4}$ of them are broken by careless handling, at what price per doll must he sell the remainder to gain $\frac{1}{5}$ of the cost of the lot?

REVIEW OF DECIMALS

1. Is a decimal a whole number or a fraction?

Tell what names are given to these decimals:

2. .67
3. .0034
4. .003456

5. Write 8 so that it shall express tenths; thousandths; hundred-thousandths.

Write in figures:

1. Five hundred sixty and forty-two hundredths.
2. Six hundred eight thousandths.

3. Three thousand twenty-eight ten-thousandths.
4. Two hundred five hundred-thousandths.
5. Seventy thousand sixty-one and thirty-two thousandths.
6. Two hundred thousand two hundred and two hundredths.

Read :

1. \$4.50 as dimes ; as cents.
2. 375 cents as dimes ; as dollars.
3. \$2 $\frac{1}{2}$ as dimes ; as cents.
4. 75 dimes as cents ; as dollars.
5. 4 $\frac{1}{2}$ dimes as cents ; as dollars.
6. 2.5 as tenths ; as hundredths.
7. .67 as tenths.
8. .256 as tenths ; as hundredths.
9. .1728 as tenths ; as hundredths ; as thousandths.
10. .3001 as tenths ; as hundredths ; as thousandths.

At sight, change to common fractions in their lowest terms :

1. .1 2. .2 3. .3 4. .4 5. .5 6. .6 7. .7 8. .8 9. .9
2. .12 $\frac{1}{2}$ 3. .16 $\frac{2}{3}$ 4. .33 $\frac{1}{3}$ 5. .37 $\frac{1}{2}$ 6. .62 $\frac{1}{2}$ 7. .66 $\frac{2}{3}$ 8. .87 $\frac{1}{2}$ 9. .83 $\frac{1}{3}$ 10. .8 $\frac{1}{2}$

Change to common fractions in their lowest terms :

- | | | | |
|----------|-----------|-----------|-----------|
| 1. .128 | 2. .325 | 3. .576 | 4. .735 |
| 5. .0825 | 6. .0225 | 7. .0525 | 8. .0045 |
| 9. .1875 | 10. .3375 | 11. .5625 | 12. .7625 |

Tell at sight the decimal equivalents in hundredths of:

- | | | | | | | |
|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|
| 1. $\frac{1}{2}$ | 2. $\frac{3}{4}$ | 3. $\frac{5}{8}$ | 4. $\frac{7}{10}$ | 5. $\frac{9}{25}$ | 6. $\frac{1}{50}$ | 7. $\frac{17}{100}$ |
| 8. $\frac{1}{3}$ | 9. $\frac{1}{6}$ | 10. $\frac{1}{7}$ | 11. $\frac{1}{8}$ | 12. $\frac{1}{9}$ | 13. $\frac{1}{11}$ | 14. $\frac{1}{12}$ |
| 15. $\frac{1}{16}$ | 16. $\frac{1}{18}$ | 17. $\frac{1}{20}$ | 18. $\frac{1}{25}$ | 19. $\frac{1}{30}$ | 20. $\frac{1}{40}$ | 21. $\frac{1}{50}$ |

Change to pure decimals:

- | | | | | |
|---------------------|---------------------|---------------------|---------------------|-----------------------|
| 1. $\frac{5}{16}$ | 2. $\frac{7}{32}$ | 3. $\frac{3}{40}$ | 4. $\frac{9}{64}$ | 5. $\frac{7}{80}$ |
| 6. $\frac{11}{128}$ | 7. $\frac{37}{128}$ | 8. $\frac{49}{160}$ | 9. $\frac{99}{250}$ | 10. $\frac{109}{480}$ |

Change to decimals, carrying out the division four decimal places:

- | | | | | |
|-------------------|-------------------|--------------------|--------------------|--------------------|
| 1. $\frac{5}{6}$ | 2. $\frac{4}{7}$ | 3. $\frac{2}{9}$ | 4. $\frac{7}{12}$ | 5. $\frac{4}{15}$ |
| 6. $\frac{1}{18}$ | 7. $\frac{5}{24}$ | 8. $\frac{11}{30}$ | 9. $\frac{17}{36}$ | 10. $\frac{1}{75}$ |

Change to mixed decimals:

- | | | | | |
|---------------------|----------------------|----------------------|-----------------------|-----------------------|
| 1. $8\frac{1}{2}$ | 2. $12\frac{3}{4}$ | 3. $15\frac{1}{5}$ | 4. $17\frac{5}{8}$ | 5. $19\frac{1}{10}$ |
| 6. $22\frac{1}{20}$ | 7. $35\frac{17}{25}$ | 8. $43\frac{21}{50}$ | 9. $64\frac{87}{100}$ | 10. $83\frac{3}{100}$ |

Change to mixed numbers:

- | | | | | |
|------------------------|------------------------|----------|-----------|-----------------------|
| 1. 7.5 | 2. 15.16 $\frac{2}{3}$ | 3. 9.25 | 4. 12.6 | 5. 8.12 $\frac{1}{2}$ |
| 6. 18.66 $\frac{2}{3}$ | 7. 14.37 $\frac{1}{2}$ | 8. 17.12 | 9. 19.875 | 10. 25.32 |

Write as pure decimals:

- | | | | | |
|----------------------|------------------------|----------------------|-----------------------|-------------------------|
| 1. .21 $\frac{1}{2}$ | 2. .33 $\frac{3}{4}$ | 3. .63 $\frac{3}{5}$ | 4. .73 $\frac{3}{10}$ | 5. .52 $\frac{7}{10}$ |
| 6. .18 $\frac{4}{5}$ | 7. .101 $\frac{2}{50}$ | 8. .12 $\frac{5}{8}$ | 9. .15 $\frac{1}{50}$ | 10. .141 $\frac{1}{40}$ |

Write as fractions having 100 for the denominator and then change to lowest terms:

- | | | | | |
|----------------------|----------------------|----------------------|----------------------|-----------------------|
| 1. .02 $\frac{1}{2}$ | 2. .03 $\frac{1}{3}$ | 3. .04 $\frac{1}{3}$ | 4. .06 $\frac{2}{3}$ | 5. .07 $\frac{1}{2}$ |
| 6. .08 $\frac{1}{3}$ | 7. .22 $\frac{2}{3}$ | 8. .38 $\frac{2}{3}$ | 9. .41 $\frac{2}{3}$ | 10. .71 $\frac{2}{3}$ |

<i>A</i>	<i>B</i>
3700.37	690.04
909.	9.09
104000.	125.00768
1408.1408	.104
6172362.908706	900000.00009
.909	.00909
90900.	900.09
3000.003	2756.00087
37500.05	10208.0006
3980.0192	100.01085

1. Read aloud the numbers in columns *A* and *B*.
2. Find the sum of column *A*. Of column *B*.
3. Subtract each number in column *B* from the number at the left of it in column *A*.

SIGHT EXERCISE

1. Multiply \$0.32 by 10; by 100; by 1000.
2. Multiply \$675 by .1; by .01; by .001.
3. How many decimal places in the product of :

$4 \times .2?$	$.5 \times .3?$	$.08 \times 7?$	$.7 \times .01?$	$.6 \times .004?$
$.2^2?$	$.02^2?$	$1.2^2?$	$.5^3?$	$.04^3?$
4. Find the products of :

$1 \times 1 \times .1$	$1 \times .1 \times .1$	$\overset{p}{.1} \times \overset{v}{.1} \times \overset{p}{.1}$
$1 \times 1 \times .01$	$1 \times .01 \times .01$	$.01 \times .01 \times .01$
5. Divide \$250 by 10; 100; 1000.
6. Divide \$0.25 by .1; .01; .001.
7. Divide 3.2 by 4; 3.2 by .4; .63 by .7.

WRITTEN EXERCISE

Solve:

- | | | |
|--|---|------------------------|
| 1. 23.64×8 | 2. 32.4×3.9 | 3. $124.65 \times .12$ |
| 4. $.0072 \times 1.5$ | 5. $8.64 \times .02$ | 6. $.045 \times 40.4$ |
| 7. $.015 \times .024$ | 8. 926.8×1.75 | 9. $.035 \times 200.2$ |
| 10. $3764 \times .0005$ | 11. 37.024×15.7 | |
| 12. $.00084 \times 245$ | 13. $1.2 \times 1.2 \times 1.2$ | |
| 14. $.03 \times .08 \times .08$ | 15. $3.2 \times .025 \times 12.8$ | |
| 16. $.45 \times 2.8 \times .016$ | 17. $.16 \times .05 \times 3.7 \times .8$ | |
| 18. $5.76 \times .4 \times .25 \times 3.2$ | 19. $12.8 \times 5.5 \times .002$ | |
| 20. $.032 \times .6 \times .75 \times 160$ | | |

Divide:

- | | | |
|-----------------------|---------------------|------------------|
| 1. 36 by .6 | 2. 28 by .04 | 3. 21 by .003 |
| 4. .72 by 8 | 5. 540 by .09 | 6. 3200 by .8 |
| 7. 3.5 by 7 | 8. .12 by .4 | 9. .54 by .009 |
| 10. .068 by .7 | 11. .0027 by .03 | 12. 2500 by .005 |
| 13. 560 by .007 | 14. 3.2 by .08 | 15. .042 by .06 |
| 16. .0004 by .008 | 17. .0056 by 8 | 18. .25 by .05 |
| 19. 5.4 by .6 | 20. .027 by 3 | 21. .024 by .008 |
| 22. 720 by .8 | 23. 1400 by .07 | 24. 84 by .012 |
| 25. 14.4 by .12 | 26. 1.44 by .012 | 27. .0004 by 5 |
| 28. .064 by 1.6 | 29. 64 by .0016 | 30. .012 by .008 |
| 31. 3.1416 by .75 | 32. .7854 by 3.1416 | |
| 33. 109.956 by 3.1416 | 34. .2456 by 3.07 | |
| 35. 3750 by 18.75 | 36. .3656 by 57.6 | |
| 37. 144 by 17.28 | 38. .0288 by .0576 | |
| 39. .1548 by 6.45 | 40. .02456 by 3.07 | |

WRITTEN PROBLEMS

1. An acre of land contains 43,560 sq. ft. How many square feet in .1 A.? .01 A.? .001 A.?

(2) Mr. Grant paid \$1.75 for recording the deed to a piece of land. This was .1 of what he paid for legal services, .01 of what he paid for grading, and .001 of what he paid for the land. How much did he pay for legal services? For grading? For the land? What was the total expense?

3. Mr. Green's property tax is \$75, and his water tax .1 as much. The amount of his property and water tax is .01 of the value of his property. Find the value of his property.

(4) A table is .75 yd. long and .5 yd. wide. What is its area in square yards? In square feet? In square inches? Its perimeter in yards? In feet? In inches?

5. A steamboat makes a trip of 147 mi. in 8.4 hr. Find the speed per hour.

(6) A piece of cardboard 20.8 in. long and 12.75 in. wide is cut to a piece 20 in. by 12 in. Find how much is wasted.

7. A load of coal contains 1.875 T. For how many pounds does the weigher make out his slip?

(8) What are the dimensions of the largest square that can be cut from a board .675 yd. long and .6 yd. wide? The area?

9. How many times must a piece of wire .02 in. in diameter be wound around a circular piece of steel 2.5 in. long to exactly cover it?

10. From a farm of 80 A. there were sold at different times .75 of it, .075 of it, and .0075 of it. How many acres were left?

11. From another farm of 80 A. there were sold 7.5 A., .75 A., .075 A., and .0075 A. How many acres were left?

12. Henry started to ride his bicycle to his uncle's home, 12.5 mi. away. After riding .38 of the distance, he broke a couple of spokes, and after riding .8 of the remaining distance he punctured a tire and walked the rest of the way. How far did he walk?

13. If 4.5 bu. of wheat are required to make a barrel of flour, how many barrels of flour can be made from the wheat harvested from 1260 A., producing 15.8 bu. an acre?

14. What is the perimeter of a park around which a man can walk in .75 hr. at the rate of .05 mi. per minute?

15. A man having \$450 in the bank drew out .32 of it at one time and .15 of the remainder at another. How much had he still on deposit?

16. Two pieces of copper wire are $\frac{7}{8}$ in. and .205 in. in diameter. Which is the larger size? By what decimal of an inch?

17. A farmer sold his crop of 1200 bu. of potatoes as follows: .125 at $\$ \frac{4}{5}$ per bushel, .2 at $\$ \frac{3}{4}$ per bushel, .25 at $\$ \frac{7}{10}$ per bushel, and the remainder at $\$ \frac{4}{5}$ per bushel. How much did he receive?

18. A load of fertilizer weighs 1475 lb. Express the weight as the decimal of a ton.

REVIEW EXERCISES

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
1.	$2\frac{1}{4}$	$5\frac{17}{100}$	$1\frac{3}{20}$	3.2	$3\frac{1}{16}$
2.	$3\frac{1}{8}$	$9\frac{1}{2}$	.64	5.06	$\frac{3}{8}$
3.	6.3	.07	3.02	$2\frac{4}{25}$	.625
4.	$4\frac{1}{2}$	3.1	2.7	1.25	5.05
5.	$5\frac{3}{8}$	5.4	$1\frac{3}{10}$	$5\frac{7}{8}$	$7\frac{1}{2}$

1. At sight, tell the least quantity that must be added to $2\frac{1}{4}$ to make an integer. Do the same with the other numbers in the table.

2. Change the common fractions to decimals, and find the sum of each column. Of all the columns.

3. Change the decimals to common fractions, and find the sum of each row. Of all the rows.

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
1.	3.2	.4	.9	.54
2.	.24	.03	9.	.54
3.	.028	.004	.9	.054
4.	63.	.07	9.	.0054
5.	.81	.009	.09	.00054
6.	.084	.07	9.	.054
7.	56.	.8	.09	.0054
8.	4.5	.05	.9	.0054
9.	72.	.008	.009	.0054

NOTE. Do at sight as much as possible of the indicated work.

1. Find the sum of each column. Of all the columns.

2. Find the sum of each row. Of all the rows.

3. Subtract each number in column B from the number at the left of it in column A.

4. Subtract each number in column D from the number at the left of it in column C.

5. Multiply each number in column A by the number at the right of it in column B.

6. Multiply each number in column D by the number at the left of it in column C.

7. Divide each number in column A by the number at the right of it in column B.

8. Divide each number in column D by the number at the left of it in column C.

FARM PROBLEMS

THE ESTIMATED PRODUCTION AND VALUE OF CERTAIN CROPS FOR
THE YEAR 1909 AS GIVEN IN A U. S. GOVERNMENT REPORT

CROP	AVERAGE YIELD PER ACRE	FARM VALUE PER BUSHEL ON DEC. 1	WEIGHT OF ONE BUSHEL
Barley	24.3 bu.	55.2 ¢	48 lb.
Buckwheat	20.9 bu.	69.9 ¢	48 lb.
Corn	25.5 bu.	59.6 ¢	56 lb.
Oats	30.3 bu.	40.5 ¢	32 lb.
Potatoes	106.8 bu.	54.9 ¢	60 lb.
Rye	16.1 bu.	73.9 ¢	56 lb.
Wheat	15.8 bu.	99 ¢	60 lb.

1. Find the farm value in dollars of the yield of one acre of each of the above crops.

2. How many tons of barley were produced from 28 acres?

3. How many bushel bags were required to ship the wheat raised on 175 acres?

4. How many acres must be planted to potatoes to raise 26,700 bushels?
5. A farmer raised 303 tons of oats. How many acres did he plant?
6. How many cars of a capacity of 30,000 pounds each were required to carry the wheat raised on 2500 acres?
7. Make up problems based on the above table.

REVIEW OF MEASUREMENTS*Oral*

1. How many pencils in $\frac{7}{12}$ of a gross?
2. How many sheets in 10 quires of paper?
3. How many reams in 24 quires?
4. Change $2\frac{3}{4}$ min. to seconds.
5. Change $3\frac{1}{2}$ da. to hours.
6. How many days in 120 hr.?
7. How many hours in a week?
8. How many score in 70 yr.? How many decades?
9. How many centuries from 614 B.C. to 1914 A.D.?
10. Repeat the table of linear or long measure.
11. A table is 2 ft. 8 in. long and 1 ft. 9 in. wide. Express its dimensions in feet. In inches.
12. What decimal part of a yard is 27 in.?
13. How many inches in 25 yd.?
14. A street is 10 rd. long and 66 ft. wide. Express its length in feet and its width in rods.
15. Change $\frac{3}{4}$ mi. to rods; 400 rd. to miles.
16. How many rods in .1 mi.?
17. Repeat the table of square or surface measure.

18. What is a rectangle?
19. When is a rectangle a square?
20. How many square inches in $\frac{7}{12}$ sq. ft.? In .5 sq. ft.?
21. What part of a square foot is 108 sq. in.?
22. Change 10 sq. ft. to square inches. To square yards.
23. How many square rods in $1\frac{3}{4}$ A.? In .6 A.?
24. How many acres in 406 sq. rd.?
25. How many 2-in. squares can be cut from a piece of paper 6 in. square?
26. How many square yards in a floor 24 ft. by 18 ft.?
27. How many acres in a lot 40 rd. by 20 rd.?
28. What is the perimeter of a 2-in. square? A 6-in. square?
29. A sheet of drawing paper 12 in. long covers 108 sq. in. What is the width?
30. How many rods of fence will inclose a field 25 rd. long whose width is $\frac{2}{3}$ its length? What is the area of the field?
31. Mrs. Winter has two flower beds. One is $6\frac{1}{4}$ ft. by 4 ft.; the other is a square whose perimeter is 24 ft. Which has the greater area? How much wire netting will be required to inclose each lot?
32. How many square feet in the bottom and sides of a tank 2 ft. by 2 ft. by 2 ft.?
33. A room is 20 ft. long, 10 ft. wide, and 9 ft. high. What is its perimeter? The area of the walls? The area of the ceiling? How many cubic feet in the room?
34. Repeat the table of cubic or volume measure.

35. What is a rectangular prism?
36. When is a rectangular prism a cube?
37. How many surfaces has a rectangular prism?
38. What is the surface area of a 5-in. cube? Its volume?
39. The surface of a cube is 24 sq. in. What is the area of each side? What are the dimensions of the cube? Its volume?
40. What is the volume of a stone block 4 ft. by 3 ft. by 2 ft.? Its surface?
41. A common brick 8 in. long and 2 in. thick contains 64 cu. in. What is its width?
42. The base of a collar box covers 15 sq. in.; its capacity is 60 cu. in. What is its depth?
43. How many 2-in. cubes can be cut from a cubical block of wood 4 in. long?
44. How many cubic yards of earth are thrown out in digging a cellar 30 ft. by 27 ft. by 6 ft.?
45. The water is 10 ft. deep in a well whose bottom covers 12 sq. ft. How many cubic feet of water in the well?
46. What is a board foot?
47. How many board feet in a board 12 ft. long, 1 ft wide, and 1 in. thick? If $\frac{7}{8}$ in. thick? If $1\frac{1}{2}$ in. thick?
48. Mr. White buys 100 planks each 8 ft. by $\frac{1}{2}$ ft. by 2 in. How many board feet?
49. How many feet of $\frac{7}{8}$ -in. flooring must be bought for a room 20 ft. by 10 ft., allowing $\frac{1}{8}$ for waste?

50. Spruce boards are $2\frac{1}{2}$ ¢ per board foot. What is the rate per M?

51. When lumber is quoted at \$60 per M, what is the rate per C? Per board foot?

52. How many cubic feet in a pile of 4-ft. wood 1 ft. long and 4 ft. high? What name is given to this quantity of wood? How many such piles make a cord? How many cubic feet in a cord?

53. At \$4 a cord, what is the value of a load of tan bark measuring 2 cd. 5 cd. ft.?

54. Repeat the table of Avoirdupois weight.

55. How many hundredweight in a long ton?

56. Change 100 oz. to pounds. 100 lb. to ounces.

57. Change 60 cwt. to tons. 60 T. to hundredweight.

58. Repeat the table of liquid measure.

59. Change 25 qt. to gallons. To pints.

60. How many gallons in 75 pt.?

61. How many half pint bottles can be filled from a gallon of cream?

62. Change 2.75 gal. to pints.

63. How many pints in 2 gal. 2 qt. 1 pt.?

64. How many cubic inches in a gallon?

65. What is the capacity in gallons of a tank whose volume is 2310 cu. in.?

66. Repeat the table of dry measure.

67. Change 25 pk. to quarts; to bushels.

68. How many quarts of beans in bag of $1\frac{3}{4}$ bu.?

69. How many bushels of oats in 16 feeds of 4 qt. each?
70. How many cubic feet of space does a bushel occupy?
71. How many bushels of barley can be put into a box 5 ft. by 4 ft. by 2 ft.?

WRITTEN PROBLEMS

- ① Telegraph poles are 10 rd. apart. If from a car window you count 9 poles in 20 sec., what is the rate of travel in miles per minute? Per hour?

2. How many reams of paper in a pile 21 in. high, if there are 224 sheets to the inch?

3. A picture frame laps over the glass $\frac{5}{16}$ in. The glass seen is $22\frac{1}{8}$ in. by $14\frac{7}{8}$ in. What are the dimensions of the glass?

- ~~4.~~ How many miles of wire will be required to inclose a lot 120 rd. by 90 rd., if the fence is 4 wires high? How many posts set 15 feet apart will be required to support the wire?

5. A real estate dealer bought a tract of land containing 5 A. for \$1089 and sold it at $2\frac{1}{2}$ ¢ per square foot. What was his profit?

6. Mr. Marsh bought an acre of land for \$600. He gave $\frac{1}{6}$ of it for a street, and cut the rest up into lots which he sold at an average price of $3\frac{1}{2}$ ¢ per square foot. What was his gain?

7. A city lot containing 7980 sq. ft. has a frontage of 70 ft.

- (a) What is its depth?
(b) What is its value at \$7260 per A.?

(c) What is the cost of fencing the back end and $\frac{1}{2}$ of each side at \$1.98 per rod?

(d) How much will it cost at 60¢ per square yard to lay a sidewalk 6 ft. wide on the street side?

(e) If the lot has on it a house 40 ft. by 30 ft. with an ell 18 ft. by 25 ft., what part of the lot does the house cover?

8. When a lot of land 80 rd. by 60 rd. costs \$720, what ought a lot half as long and half as wide to cost?

9. At \$6.25 per square (100 sq. ft.), what will it cost to slate a roof 36 ft. long, whose rafters are 18 ft. long?

10. A mill is 440 ft. long and 198 ft. wide. (a) How many acres does it cover? (b) What part of a mile is the distance around it?

X 11. What is the volume of a block of marble 5 ft. long, $2\frac{1}{2}$ ft. wide, and 18 in. thick? How many square feet in the surface?

12. A piazza roof 9 ft. 8 in. by 4 ft. 10 in. is covered with sheets of tin 15 in. square. Each sheet is turned over $\frac{1}{4}$ in. on each edge to make the joints. How many sheets?

X 13. At \$7.80 per M, what is the value of a pile of bricks 20 ft. by 15 ft. by 12 ft., each brick being 8 in. by 4 in. by 2 in.?

14. Find the cost at 85¢ a yard of carpeting a room $17\frac{1}{2}$ ft. long and 13 ft. wide with carpet 1 yd. wide.

15. How much would it cost to carpet the room in problem 14 with carpet 27 in. wide at \$1.75 per yard?

X 16. How many board feet in a stick of timber 8 ft. long 1 ft. 6 in. wide, and $4\frac{1}{2}$ in. thick?

~~17.~~ A dealer received a carload of oats from the West for which he paid \$336. The inside dimensions of the car were 28 ft., 8 ft., and 6 ft. 3 in., and the oats occupied $\frac{4}{5}$ the space. What was the price per bushel?

18. At \$1.75 per square yard; find the cost of laying a hardwood floor in a room $16\frac{1}{2}$ ft. by 15 ft.

19. How many square yards of plastering in the walls and ceiling of a room 18 ft. long, $16\frac{1}{2}$ ft. wide, and $10\frac{1}{2}$ ft. high, and having 4 windows each 6 ft. by 3 ft., and 2 doors each 9 ft. by 3 ft. 9 in.?

20. (a) Bought a house lot 66 ft. by 132 ft. at 28¢ per square foot; (b) fenced it at \$3.20 per rod; (c) laid a 6-ft. sidewalk on the front (66 ft.) at 50¢ per square yard; (d) built a house 44 ft. by 33 ft. for \$4200; (e) raised the grade of the land not occupied by the house 6 in., paying 50¢ per load for filling. What was the total cost?

21. At 6¢ per square foot, what is the cost of tinning a tank 30 in. by 21 in. by 18 in.?

Find the capacity in bushels of the following bins:

	LENGTH	WIDTH	DEPTH
22.	20 ft.	16 ft.	6 ft.
23.	24 ft.	21 ft.	10 ft.
24.	15 ft.	12 ft.	7 ft.
25.	$4\frac{3}{8}$ ft.	$4\frac{1}{2}$ ft.	5 ft.
26.	8 ft. 4 in.	3 ft.	6 ft.
27.	7 ft.	$3\frac{1}{2}$ ft.	$7\frac{1}{2}$ ft.
28.	6 ft. 9 in.	3 ft. 4 in.	4 ft. 3 in.
29.	4.5 ft.	2.5 ft.	4 ft.

Find the capacity in gallons of the following tanks:

	LENGTH	WIDTH	DEPTH
30.	28 in.	22 in.	18 in.
31.	11 ft.	7 ft.	6 ft.
32.	$5\frac{1}{2}$ ft.	$3\frac{1}{2}$ ft.	$3\frac{1}{2}$ ft.
33.	7 in.	$5\frac{1}{2}$ in.	1 ft.
34.	$3\frac{1}{2}$ ft.	$2\frac{3}{4}$ ft.	$2\frac{1}{2}$ ft.
35.	3 ft.	22 in.	1 ft. 9 in.
36.	4 ft. 8 in.	4 ft. 6 in.	3 ft. 8 in.
37.	5.5 ft.	3.5 ft.	2.25 ft.

38. A tin pan 28 in. long and 15 in. wide was filled to the depth of $1\frac{3}{8}$ in. during a rain. How many gallons of water in the pan?

39. A tank 12 ft. by 8 ft. by 5 ft. is full of water. What is the weight of the water in tons? (A cubic foot of water weighs $62\frac{1}{2}$ lb.)

40. The base of a railroad water tank covers 320 sq. ft. The tank is 12 ft. deep. How many tons of water will it hold?

41. A cubic foot of water weighs 62.5 lb. Granite is 2.8 times as heavy as water. Find the weight of a block of granite 6 ft. long, 2 ft. wide, and $1\frac{1}{2}$ ft. thick.

42. By what must 84 be multiplied to get 8148 for a product?

43. The product of two numbers is 5412. One of the numbers is 82. What is the other?

44. The length of a rectangular lot is 43 ft., and its area is 1462 sq. ft. What is its width?

45. A field 40 rd. long contains 8 A. How many square rods in the field? What is its width?

Find the missing dimensions :

	LENGTH	WIDTH	AREA		LENGTH	WIDTH	AREA
46.	?	24 ft.	1440 sq. ft.	47.	9 ft.	?	6 sq. yd.
48.	20 rd.	?	$2\frac{1}{2}$ A.	49.	?	32 rd.	$9\frac{3}{8}$ A.

Find the missing dimensions :

	LENGTH	WIDTH	HEIGHT	VOLUME
50.	15 in.	12 in.	?	1620 cu. in.
51.	$3\frac{3}{4}$ ft.	?	4 ft.	40 cu. ft.
52.	?	4 ft.	6 ft.	192 bu.
53.	3 ft. 6 in.	3 ft. 4 in.	?	56 bu.
54.	14 in.	?	11 in.	8 gal.
55.	?	$3\frac{1}{2}$ ft.	4 ft.	576 gal.

56. A bin 8 ft. square has a capacity of 256 bu. How deep is it?

57. A tank holding 288 gal. is $3\frac{3}{4}$ ft. long and 3 ft. wide. How deep?

58. If a can 21 in. high holds 8 gal., what must be the area covered by the base?

59. A paint manufacturer puts up varnish in quart cans. The cans are 5 in. high and 3.85 in. long. How wide are they?

60. Find the total cost of the following lumber used for supporting, sheathing, flooring, and roofing an inexpensive summer camp.

28 posts, 6 in. \times 6 in., @ \$0.25.

2000 sq. ft. pine siding, @ \$17 per M.

2375 sq. ft. sheathing, @ \$12 per M.

2800 sq. ft. building paper, @ \$0.20 per 100 square feet.

900 sq. ft. subflooring, @ \$12 per M.

1950 sq. ft. matched flooring, @ \$23 per M.

660 lineal feet strips, @ 2¢ per foot.

1500 cypress sap shingles, for gables, @ \$4.25 per M.

6150 cypress heart shingles, for roof, @ \$6.50 per M.

61. Mr. Hanson has two fields, each of which requires 144 rd. of fence. One field is 45 rd. long, and the other is a square. Find the number of acres in each.

62. A farmer has a field containing $15\frac{1}{2}$ A. He fences off a piece 40 rd. by 20 rd., which he plants to corn. The rest he uses as a pasture. How many acres are planted? What part of the field is used as a pasture?

63. The floor space of a cellar is 32 ft. by 27 ft. How many cubic feet in the walls which are 9 ft. high and $1\frac{1}{2}$ ft. thick?

TROY WEIGHT

Troy weight is used in weighing gold, silver, and precious stones.

TABLE OF TROY WEIGHT

24 grains (gr.)	= 1 pennyweight (pwt.)
20 pennyweights	= 1 ounce (oz.)
12 ounces	= 1 pound (lb.)

Fill the blanks :

1 lb. = oz. = pwt. = gr.

The Troy pound contains 5760 grains; the Avoirdupois pound, 7000 grains.

The coins now minted by the United States government are:

Gold: Quarter Eagle, \$2.50; Half Eagle, \$5.00; Eagle, \$10.00; Double Eagle, \$20.00.

Silver: Dime; Quarter Dollar; Half Dollar; Dollar.

Nickel: 5-cent piece.

Bronze: 1-cent piece.

1. Gold coins are $\frac{9}{10}$ pure gold and $\frac{1}{10}$ pure copper. What per cent of each metal in a gold coin?

The standard unit of value is the gold dollar, which weighs 25.8 Troy grains.

2. Find the number of Troy grains of pure gold in a gold dollar. The number of grains of pure copper.

NOTE. The gold dollar is not now minted.

3. Fill out this table:

GOLD COINS	WEIGHT: Troy Grains	PURE GOLD: Troy Grains	PURE COPPER: Troy Grains
Quarter Eagle			
Half Eagle			
Eagle			
Double Eagle			

4. Silver coins are $\frac{8}{10}$ pure silver and $\frac{1}{10}$ pure copper. How many Troy grains of pure silver in a silver dollar which weighs 412.5 Troy grains?

5. The 5-cent piece is 3 parts copper and 1 part nickel. What per cent of each metal in a nickel?

6. The 1-cent piece is 19 parts copper and 1 part tin and zinc. What per cent of the 1-cent piece is copper? What per cent tin and zinc?

PERCENTAGE

What does the expression per cent mean? The sign %?

TERMS USED IN PERCENTAGE

The whole or the base; the number or quantity of which a certain number of hundredths is to be taken.

The part or the percentage; the part of the whole taken.

The value of the part or the per cent; the number of hundredths of the whole taken.

The part and the value of the part represent the same thing, and are therefore equal.

1. At sight, tell the fractional equivalents of :

1 %	2 %	$2\frac{1}{2}$ %	3 %	$3\frac{1}{2}$ %	4 %
5 %	6 %	$6\frac{1}{4}$ %	$6\frac{3}{4}$ %	8 %	$8\frac{1}{2}$ %
$9\frac{1}{11}$ %	10 %	$11\frac{1}{3}$ %	12 %	$12\frac{1}{2}$ %	$14\frac{1}{4}$ %
15 %	16 %	$16\frac{2}{3}$ %	20 %	25 %	30 %
$33\frac{1}{3}$ %	40 %	50 %	60 %	$62\frac{1}{2}$ %	$66\frac{2}{3}$ %
70 %	75 %	80 %	$83\frac{1}{3}$ %	$87\frac{1}{2}$ %	90 %

Subtract each of the above per cents from 100 %.

2. Write decimally :

150 %	125 %	$116\frac{2}{3}$ %	120 %	$112\frac{1}{2}$ %	106 %
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3. Write decimally :

$\frac{1}{2}$ %	$\frac{1}{4}$ %	$\frac{1}{5}$ %	$\frac{1}{8}$ %	$\frac{1}{3}$ %	$\frac{3}{4}$ %	$\frac{1}{10}$ %
-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	------------------

4. Write with the sign % :

1	1.5	$1\frac{1}{4}$	$1\frac{1}{3}$	1.25	1.02	.07	$.03\frac{1}{2}$
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SIGHT EXERCISE

Tell the missing terms:

	WHOLE OR COST	PART OR PERCENT- AGE	VALUE OF PART OR RATE		WHOLE OR COST	PART OR PERCENT- AGE	VALUE OF PART OR RATE
1.	\$56	??	$12\frac{1}{2}\%$	12.	\$32	4%	125%
2.	15%	\$25	$16\frac{2}{3}\%$	13.	34	\$36	150%
3.	\$48	\$16	$23\frac{1}{3}\%$	14.	\$60	\$72	?
4.	13%	\$60	$37\frac{1}{2}\%$	15.	27	\$45	$166\frac{2}{3}\%$
5.	\$54	4%	$83\frac{1}{3}\%$	16.	\$20	34	170%
6.	\$40	\$56	4%	17.	\$32	\$52	162.5%
7.	\$52	39	75%	18.	\$25	\$40	?
8.	\$64	\$56	87.5%	19.	?	\$65	130%
9.	90	\$25	$62\frac{1}{2}\%$	20.	\$150	?	2%
10.	\$800	2%	$2\frac{1}{2}\%$	21.	\$600	?	$3\frac{1}{3}\%$
11.	\$1200	3%	$\frac{1}{4}\%$	22.	\$1000	\$5	?

ORAL PROBLEMS

① Everett earned \$1.50 and spent 20% of it for books. How much had he left? 1.20

② If 40 acres, or 25%, of Mr. Carter's farm is pasture, how many acres in the whole farm? 160 acres

3. If 10% of a sum of money is \$30, what is 1% of it? 100%, or the whole? \$3.00 or 300

4. The boys in the Marshall School won 5 of the 8 games of hockey. What per cent? $62\frac{1}{2}\%$

5. The boys in the Phillips School won 8 games and lost 4. What per cent did they win? $66\frac{2}{3}\%$

6. A farmer raised 72 bushels of barley and 25 % more bushels of wheat. How many bushels of wheat? *90 bu*

7. Randolph sold 40 pigeons. If this was 25 % of his flock, how many had he at first? *160*

8. A clerk receiving \$20 a week had his wages increased \$5. What was the per cent of increase? *25%*
What per cent of his former wages did he then receive? *125%*

9. An agent sold 24 reapers in one month, and 16 $\frac{2}{3}$ % more the next month. How many in both months? *56 reapers*

10. If in making ice cream 1 pint of cream is mixed with 2 quarts of milk, what per cent of the mixture is pure cream? *20%*

11. If the cream costs 40 cents a quart and the milk 10 cents a quart, what per cent of the total cost is paid for cream? *50%*

12. If 20 % of a crop of hay is sold for \$40, what is the value of the whole crop? *\$200*

13. How much is 100 % of \$6350? 10 %? 1 %? .1 %? *\$6350, \$635, \$63.5, \$6.35*

14. What per cent of a quire of letter paper is left after 15 sheets have been used? *40%*

15. Mr. Sanders paid \$80 for a cow and 5 % as much for a sheep. How much for the sheep? *\$40*

16. Nelson sold 80 boxes of strawberries in June and 100 boxes in July. What was the per cent of increase? *25%*

17. Mr. Marston runs his touring car 12 miles on a gallon of gasoline. This is 66 $\frac{2}{3}$ % of the distance Mr. Brown can run his runabout on the same quantity. How many miles can Mr. Brown run his machine on a gallon of gasoline?

18 miles

18. What per cent of profit does a selling price of \$0.64 represent if the cost is \$0.40? *20%*

19. Mr. Strong's water tax entitles him to 5000 gallons a year. What per cent of his allowance is unused if he uses but 3500 gallons? *30%* By what per cent ought his tax to be increased if he uses 6000 gallons? *133%*

(20.) A newsboy buys papers at $\frac{1}{2}$ ¢ each and sells them at a cent apiece. What per cent does he make? *100%*

WRITTEN PROBLEMS

1. A ton of iron ore produced 840 lb. of iron. What per cent of the ore was iron?

(2) A dealer in furniture made 30% by selling a sideboard for \$52. Find the cost.

(3) Mr. Edwards bought a horse for \$180, kept him 4 weeks at a cost of 35¢ a day, paid \$1.35 for shoeing, and then sold him for 18% more than the entire cost. Find the selling price.

4. The steamer fare between two places is 75¢. This is 25% less than the fare by rail. How much by rail?

(5) What per cent of an acre is a lot 12 rd. by $8\frac{1}{2}$ rd.?

(6) A man invested \$6240 in a woolen mill and received a dividend every three months equal to 2% of his investment. Find his annual income.

(7) The distance by rail from Buffalo to Cleveland—180 miles—is 50% of the distance from Cleveland to Chicago. How many miles from Buffalo to Chicago?

8. A hardware dealer sells one kind of lawn mower for \$5 and another for \$6, making \$1 on each. On which does he make the greater per cent?

9 A merchant buys shovels for 60 cents and sells them for 85 cents. What per cent does he gain?

10. By selling goods at 6% below cost a grocer lost \$14.40. Find the selling price.

11. Three fourths per cent of the 6000 trees in a city were blown down in a violent storm. How many trees were destroyed?

12. A farmer bought 75 sheep for \$410. He sold 40% of them at \$6 apiece, and the remainder at \$6.40 apiece. Find his gain. His gain per cent.

13. Thirty-three and one third per cent of a 42-gallon barrel of gasoline was sold at 15 cents a gallon, and the remainder at 16 cents a gallon. How much was received for it?

14. From a lot 20 rods by 16 rods there are sold $1\frac{1}{4}$ acres. What per cent?

15. A man having a bank account of \$872 withdrew 32% of it and then 25% of the remainder. How much had he left on deposit? Q.S.C.
12
3.3

16. What is the difference between $\frac{3}{4}$ of \$576 and $\frac{3}{4}\%$ of \$576?

17. The average daily circulation of a newspaper is 169,236 copies. This is 8% more than last year. What was the circulation last year?

18. What is the gain per cent in selling cereal at 10¢ per package if a case of 2 dozen packages costs \$1.80?

19. Ellen bought a pocketbook for \$0.90 just after Christmas. She paid 40% less than was asked for it before Christmas. Find the price before Christmas.

20. For cash trade a grocer gives checks which he redeems either in cash or in goods at the rate of 50¢ for ten dollars' worth of checks. This is equivalent to what per cent?

21. Out of the 200 fruit trees in an orchard 28 were destroyed. What per cent?

22. Out of the 200 fruit trees in an orchard 28 % were destroyed. How many?

23. A merchant ordered 560 barrels of flour. He received $71\frac{1}{2}$ % of his order at one time and the balance at another time. How many barrels at each shipment?

24. What is the gain per cent when lace costing \$2.70 by the 10-yd. piece is sold at 36¢ per yard?

25. A salesman receives \$80 per month and $21\frac{1}{2}$ % on all sales. What was his income in a month in which his sales averaged \$150 per day and he worked 26 days?

26. Find the cost of a book which sold at \$0.84 gives a profit of 12 %.

27. After selling 187 acres Mr. Baker had 32 % of his farm left. What was the original acreage?

28. A milk dealer runs two delivery teams. One distributes 340 qt. daily. This is 85 % of the quantity distributed by the other. How many quarts by both teams?

29. A drover bought 80 sheep @ \$4.25, and sold 40 % of them @ \$5.25 and the remainder for 20 % more than their cost. Find the average selling price.

30. A farmer kept 36 % of his crop of turnips for his stock and sold 160 bu. How many bushels did he raise?

31. Mr. Carpenter paid \$3680 for a house and lot. After laying out \$148 in repairs, and paying a tax bill of \$52, he rented the property for a year at a profit of $12\frac{1}{2}\%$ on the investment. Find the income.

32. What per cent does a fruit dealer make in buying grape fruit at \$3.15 per box of 54 fruit and selling them at the rate of 3 for a quarter?

33. Mr. Foster has received the following offers for a lot of land which cost him \$1650: (1) \$240 more than he paid; (2) 14% more than he paid. Which is the better offer, and by how much?

34. An agent earned \$1400 in one year, and $28\frac{1}{4}\%$ more in the following year. How much in the two years?

35. On a lot 20 rd. by 16 rd. stands a schoolhouse 99 ft. by 77 ft. What per cent of the lot can be used for a playground?

36. A farmer bought 76 sheep at \$5.75 apiece and sold them for \$414. Did he gain or lose? What per cent?

37. What is the gain per cent on pepper bought at 28¢ per pound and sold at 10¢ per 4-oz. package?

38. A hardware merchant makes a profit of 40%, or 32¢, on saws. Find the cost. The selling price.

39. A farmer sold two lots of wheat for \$360 each. On one lot he gained 25% and on the other he lost 25%. Did he gain or lose by the sale? How much?

40. A clothier has two grades of hats; the cheaper grade he buys for \$2 and sells for \$2.50; the other grade he buys for \$2.50 and sells for \$3. On which grade does he make the greater per cent of profit?

41. The following statement of the elements of cost of a dozen eggs purchased in the summer of 1909 by a New York consumer, is taken from a report of the United States Department of Agriculture:

	Cents
Paid the farmer in Iowa	15
Gross profit of shipper	$\frac{3}{4}$
Freight to New York	$1\frac{1}{2}$
Gross profit of receiver	$\frac{1}{2}$
Gross profit of jobber	$1\frac{1}{4}$
Loss from candling	2
Gross profit of retailer	4
Cost to consumer	<u>22</u>

Find the cost to the consumer. What per cent of the cost to the consumer is represented by each item?

42. From a farm of 50 A. 100 sq. rd., 32 A. 145 sq. rd. were sold. What per cent?

43. A man receiving a salary of \$1000 had his salary increased 20 % one year, and the following year had it reduced 20 %. What was his salary then?

44. At a forced sale, handkerchiefs, costing \$72 per case of 6 gross, were sold for 76¢ per dozen. What was the loss per cent?

45. A farmer raised 355 bu. of onions. One fifth of them were unsalable; 25 % of the remainder were frozen during the winter. What per cent of his crop could he sell? How many bushels?

46. Mr. Barton bought an overcoat for \$24. The cost of his overcoat was 75 % of the cost of his suit. How much did he pay for both?

47. In 1908 a farmer cultivated 80 acres. In 1909 he cultivated 20 % more than in 1908; in 1910, 25 % more than in 1909; and in 1911 30 % more than in 1910. How many acres did he cultivate in 1911?

48. The following is a newspaper clipping concerning prices of coffee:

Local quotations have been rising and today high-grade blends, which early in the year were selling at 25c, bring 28c; high grades have advanced from 22c to 25c; medium grades from 19c to 23c; common grades from 16c 21c; and the low grades from 14c to 18c.

Find the per cent of increase in price of high-grade blends. Of high grades. Of medium grades. Of common grades. Of low grades.

49. An office boy received \$240 the first year he worked for a firm. The second year he received an increase of \$60. The third year he received the same per cent of increase as the second year. What was his salary the third year?

50. Four towns — Conway, Deerfield, Sunderland, and Whately — unite in hiring a superintendent of schools at a salary of \$750. Conway pays 30 % of the salary, Deerfield 40 %, Sunderland 20 %, and Whately 10 %. Find the amount paid by each town. To this salary the state adds \$850, apportioning it among the towns on the same basis that the towns pay. How much does the state contribute to each town?

51. Mr. A sold his horse to Mr. B at a gain of 20%; Mr. B sold it to Mr. C for \$195, thereby gaining 25%. How much did the horse cost Mr. A?

A DAIRY PROBLEM

The following table is taken from a bulletin issued by the Department of Agriculture:

SAMPLE OF FARMER'S MILK RECORD FOR ONE WEEK, FROM
JULY 30, P.M., TO AUGUST 6, A.M.

NUMBER OF MILKING	YIELD OF MILK							
	Spotty	Black No. 1	Black No. 2	Bottle	Milly	Belle	Alice	Pet
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
1 . . .	20.5	14.1	11.3	15.0	15.4	10.9	6.9	15.1
2 . . .	13.5	6.8	6.5	10.2	13.2	8.3	5.2	10.3
3 . . .	22.2	16.8	11.7	15.0	17.0	11.0	6.7	15.8
4 . . .	14.2	5.2	8.2	10.7	14.2	8.5	5.2	10.9
5 . . .	20.3	15.7	6.0	13.7	16.3	10.7	6.8	15.7
6 . . .	16.7	7.0	9.2	11.9	15.6	9.5	5.1	12.2
7 . . .	18.5	15.5	4.7	14.1	16.7	9.6	7.0	14.5
8 . . .	16.0	7.8	7.3	11.2	14.4	8.7	5.0	14.7
9 . . .	22.0	14.5	13.5	16.4	18.5	10.7	6.9	15.8
10 . . .	14.0	9.5	6.9	10.5	15.0	8.3	4.8	11.4
11 . . .	19.9	9.8	4.0	12.9	17.5	11.0	6.7	14.9
12 . . .	14.5	13.0	6.8	11.5	14.5	8.1	4.4	11.3
13 . . .	22.6	13.2	6.7	16.1	18.4	11.6	8.6	16.1
14 . . .	15.4	7.1	8.8	11.3	14.7	8.6	4.3	11.7
Total								
Fat, percent	3.2	2.8	3.2	3.5	3.2	3.4	4.6	3.0
Fat, pounds								

1. Find the total number of pounds of milk given during the week by each cow. By the herd. (Keep answers.)
2. Find the total number of pounds of butter fat produced by each cow. By the herd.
3. At 24¢ a pound, what was the value of the butter fat produced by each cow? By the herd?

COMMISSION

Oral

Goods sent to an agent to be sold are a *consignment*; the person sending the goods is the *consignor*; and the person to whom the goods are sent is the *consignee*.

What is commission?

Define gross proceeds. Net proceeds.

The principles of percentage apply to problems in commission.

The gross proceeds are the whole or the base.

The commission
The net proceeds } are the part or the percentage.

The rate of commission is the value of the part or the rate per cent.

1. The gross proceeds are \$250; the commission \$6.25.
Find the net proceeds.

2. The gross proceeds are \$275; the net proceeds \$260.
Find the commission.

3. The net proceeds are \$432; the commission \$18.
Find the gross proceeds.

4. Find the net proceeds when the gross proceeds are \$350, the charges for cartage \$3.50, and the commission \$14.

5. A farmer sold for a neighbor 5 pigs at \$8 each and received 10 % of the money for his trouble. Find the gross proceeds; the commission; the net proceeds.

6. Ralph received \$2 for selling 100 packages of tea at 10 cents a package. This was what per cent commission?

7. Mr. Dodge sent to his agent a ton of cabbage which the agent sold at \$1.50 per hundredweight. The agent's commission was 10 % and the freight and cartage charges \$4. Find the net proceeds.

8. A lawyer was given an account of \$200 to collect. He collected 75 % of the account and charged a fee of 10 % of the amount collected. Find his commission. The net proceeds.

9. A commission house retains \$5 and remits \$95 to the consignor. What per cent does the house charge for its services?

10. A real estate agent charged \$200 for selling a farm for \$4000. Find the rate of commission.

11. Mr. Cass receives a commission of \$60 for selling a farmer's horses. This is 10 % of the selling price. Find the selling price.

ORAL OR WRITTEN EXERCISES

Find the commission and the net proceeds on the following sales :

AMOUNT OF SALES	RATE OF COMMISSION	AMOUNT OF SALES	RATE OF COMMISSION
1. \$600	5 %	2. \$400	2½ %
3. \$1000	3½ %	4. \$1200	6 %
5. \$1600	4 %	6. \$1500	5 %
7. \$1000	7½ %	8. \$2500	8 %
9. \$4000	3 %	10. \$6000	2½ %

Find the per cent commission on the following sales :

	GROSS PROCEEDS	COMMISSION		GROSS PROCEEDS	NET PROCEEDS		NET PROCEEDS	COMMISSION
1.	\$200	\$10	2.	\$400	\$380	3.	\$90	\$10
4.	\$500	\$50	5.	\$160	\$140	6.	\$38	\$2
7.	\$1200	\$60	8.	\$150	\$140	9.	\$70	\$10
10.	\$1600	\$80	11.	\$200	\$198	12.	\$55	\$5
13.	\$2000	\$60	14.	\$500	\$450	15.	\$60	\$4

WRITTEN PROBLEMS

① When \$480 of the \$3200 received for a touring car goes to the agent, what per cent commission does the agent receive?

② At 5 % commission, what were the earnings in one week of an auctioneer who sold property as follows: \$6075, \$4500, \$10,500, and \$7825?

③ A real estate agent sold a piece of property for \$3680, charging 5 % for selling and $\frac{1}{2}$ % for advertising. Find the net proceeds.

4. What were the gross proceeds of a sale of farm produce when the consignee retained \$48 and remitted \$592 to the consignor? What per cent commission did the consignee charge?

5. Mr. Wheeler owns and rents a house for \$35 a month, paying his agent 5 % commission for making the collections. Find the amount paid to the agent in one year.

⑥ The gross proceeds of a sale of strawberries were \$506. The charges were: express, \$3.75; cartage, \$2.80; agent's commission, 5 %. Find the net proceeds.

7. Baker and Gates, commission merchants, charged \$6.65 for selling 76 barrels of potatoes at \$1.75 per barrel. Find the per cent of their commission.

8. Mr. Garvin sent a shipment of 1250 baskets of grapes to a commission house, which the house sold at 14 cents each, charging a commission of $2\frac{1}{2}\%$. Find the gross proceeds; the commission; the amount remitted to Mr. Garvin.

9. Mr. Sladen sent 240 bushels of pears to Davis and Frost, commission merchants. Fifteen per cent of the shipment was worthless, and the remainder was sold at 75¢ a bushel. Find Davis and Frost's commission at $3\frac{1}{2}\%$.

10. Consignment, 12,500 pounds of fish; consignor, C. H. Ripley; consignees, March and Street; selling price, 6¢ per pound; express charges, \$22.50; consignee's services, \$37.50. Find the per cent of the gross proceeds remitted to the consignor.

11. Mr. Cross telegraphed his agent to buy 225 barrels of flour at the market rate. If the market rate was \$4.80 per barrel, how much did Mr. Cross remit to pay for the purchase and the agent's commission of 3%?

12. An agent having on hand \$2000 of his employer's money receives instructions to buy 5000 yards of muslin. He buys at 32¢ a yard and charges a commission of 3%. How much of his employer's money has he still on hand?

13. What per cent commission is charged by an agent who retains \$49.20 and remits \$1590.80 to his employer?

14. What per cent is charged by a firm for selling a consignment of onions for \$274 if \$260.30 is remitted to the consignor?

15. Mr. Shaw bought apples at \$1.80 a barrel which he shipped to a commission firm at an expense of 20 cents a barrel. The firm sold the apples at \$2.75 a barrel, charging a commission of 2 %. Find Mr. Shaw's gain on 150 barrels.

16. Mr. Patterson told his agent to sell a piece of property for not less than \$3600, agreeing to pay him \$100, and 25 % of the amount received in excess of \$3600. The agent sold the property for \$3980. How much should the agent remit to Mr. Patterson?

COMMERCIAL OR TRADE DISCOUNT

Any deduction from an amount due or from a standard or fixed price is a discount.

A deduction from the list price of goods is *commercial* or *trade discount*.

Manufacturers and wholesalers issue catalogues and price lists of their goods from which discounts are allowed to retailers. By varying the discounts, prices may be changed without the expense of issuing new catalogues, and different discounts may be given dependent on the quantity of goods purchased.

The principles of percentage apply to problems in discount.

The list price is the whole or the base.

The discount is the part or the percentage.

The rate of discount is the value of the part or the rate per cent.

WRITTEN PROBLEMS

1. A high school bought 7 typewriters listed at \$75 at a discount of 40 %. How much was paid ?
2. Find the net price of $1\frac{1}{2}$ dozen table knives at \$0.20 each, at 5 % discount.
3. A grocer bought 6 cases of cereal, 3 dozen packages to a case, at 12 cents per package, less 20 %. How much did he pay ?
4. Mr. Appleton was offered a set of encyclopedias (8 volumes) at \$3.65 per volume with a discount of 15 %. Find the net price of the set.

THE NATIONAL SEED COMPANY

Dealers in Farm Supplies

1242 State Street

Terms:

Net, 60 days

St. Louis, April 7, 1911.

Cash, 5 % off

SOLD TO JAMES P. HARRISON, HANNIBAL, MO.

20	Bu. Potatoes	@	1.00				
7	Bu. Barley		1.50				
5	Bu. Rye		1.25				
$3\frac{1}{2}$	Bu. Japanese Millet		2.00				
$2\frac{1}{2}$	Bu. Timothy		3.00				
$\frac{3}{4}$	Bu. Turnip		.60				
	Less 5 %						

5. Complete the above bill, making the proper discount for payment on date of purchase.

6. Mr. Lawson bought a set of tires for his runabout at $7\frac{1}{2}\%$ less than the list price, which was \$60 a tire. How much did he pay?

7. What is the per cent of discount when a piano listed at \$375 is sold for \$75 less than the list price?

8. At a clearance sale in a clothing store the tag on a suit reads ~~\$16.50~~ \$11.00. The figures above the line mean the ordinary price; the figures below, the present price. What is the per cent of reduction?

DISCOUNT SERIES

Sometimes several discounts are allowed. In such cases, after the first discount is made, the second discount is reckoned on the remainder, and so on.

1. A carriage manufacturer lists a certain style of carriage at \$350 with successive discounts of 40%, 20%, and 5%. Find the net price.

Study these solutions:

- | | |
|--------------------------|--------------------------------------|
| (1) 40% of \$350 = \$140 | $\$350 - \$140 = \$210$ |
| 20% of \$210 = \$42 | $\$210 - \$42 = \$168$ |
| 5% of \$168 = \$8.40 | $\$168 - \$8.40 = \$159.60$ |
| (2) 60% of \$350 = \$210 | (since 40% is deducted, 60% is paid) |
| 80% of \$210 = \$168 | (since 20% is deducted, 80% is paid) |
| 95% of \$168 = \$159.60 | (since 5% is deducted, 95% is paid) |

2. The catalogue of an automobile manufacturer reads "Model X, 1912 style, \$1800, $33\frac{1}{3}\%$ off." How much must the retailer pay if he is allowed a further discount of 5% for cash payment?

Find the net price at sight :

LIST PRICE	DISCOUNTS	LIST PRICE	DISCOUNTS
3. \$50	20 %, 10 %	4. \$48	16 $\frac{2}{3}$ %, 10 %
5. \$80	25 %, 12 $\frac{1}{2}$ %	6. \$36	33 $\frac{1}{3}$ %, 12 $\frac{1}{2}$ %
7. \$40	25 %, 10 %	8. \$60	25 %, 20 %
9. \$20	20 %, 12 $\frac{1}{2}$ %	10. \$32	50 %, 25 %
11. \$64	12 $\frac{1}{2}$ %, 12 $\frac{1}{2}$ %	12. \$30	33 $\frac{1}{3}$ %, 20 %

WRITTEN PROBLEMS

- ① Find the net amount of a bill for \$480 with successive discounts of 25 % and 20 %.
2. A merchant buys goods whose list price is \$1080. Find the net price if he is allowed discounts of 33 $\frac{1}{3}$ %, 20 %, and 3 %.
- ③ A city buys 100 school desks and seats, listed at \$3.60 per desk and seat. Find the net cost if discounts of 25 % and 10 % are allowed.
4. Find the net amount of a bill for 50 geographies @ \$1.00, and 80 arithmetics @ \$0.65, with discounts of 16 $\frac{2}{3}$ % and 3 %.
- ⑤ On Aug. 7 a merchant buys hardware to the amount of \$850, with discounts of 20 % and 10 %, and paints to the amount of \$1360, with discounts of 25 % and 15 %. An extra discount of 5 % is to be allowed if paid within 10 days. How much will settle both accounts on Aug. 15? On Aug. 20?
6. The American Coal Mining Co. allows a discount of 16 $\frac{2}{3}$ % to purchasers of 500 tons, and 16 $\frac{2}{3}$ % and 10 %, to purchasers of 1000 tons. Find the net price per ton in each case if the price at the mine is \$3.24 per ton.

7. Two dealers in farm implements advertise plows at \$32. One dealer gives discounts of 25 % and 25 %. Find his net price. The other gives discounts of 30 % and 20 %. Find his net price.

8. A manufacturer of clothing listed a certain grade of suit at \$24, but told his clerk to allow discounts of 25 % and 15 %. The clerk called the two discounts equal to a single discount of 40 %. How much did the dealer expect to receive for the goods? How much did he receive?

9. A contractor received the following bids for structural steel girders: \$3750, with discounts of 15 % and 5 %; \$3680, with discounts of 10 % and 10 %; \$3800, with a discount of 20 %. Which bid did he accept?

10. Find the amount required to settle the bill for the following goods:

ARTICLES	GROSS COST	DISCOUNTS
Lace	\$88	30 % and 5 %
Thread	\$14.50	20 % and 10 %
Handkerchiefs	\$76.50	33 $\frac{1}{3}$ % and 20 %
Hose	\$375	20 % and 5 %
Prints	\$1280	25 % and 15 %

INSURANCE

A contract for protection against loss is *insurance*.

There are two kinds of insurance — *personal insurance* and *property insurance*.

Personal insurance is of various kinds, as, for instance, protection against:

Loss of life — life insurance.

Loss of health — health insurance.

Loss by accident to one's person — accident insurance.

Property insurance is, also, of various kinds, as, for instance, protection against :

Loss by fire — fire insurance.

Loss by marine disasters — marine insurance.

Loss of cattle, etc., — live stock insurance.

Loss by burglary — burglary insurance.

The written contract given by the insurer to the insured is the *policy*. The policy is written for a stated period of time. The amount agreed to be paid is the *face* of the policy.

The parties writing the contract are the *underwriters*.

The price paid for insurance is the *premium*.

The rate of insurance may be expressed as a rate per cent, or as so much per \$100 or \$1000 of insurance.

Thus, the rate of insurance on a piece of property is said to be $1\frac{1}{4}\%$, \$1.25 per \$100, or \$12.50 per \$1000.

The principles of percentage apply to problems in insurance.

The face of the policy is the whole or the base.

The premium is the part or the percentage.

The rate of insurance is the value of the part or the rate per cent.

ORAL PROBLEMS

1. Find the premium for insuring a house against fire for \$2000 at $1\frac{1}{2}\%$.
2. At 1%, how much must a merchant pay for insuring his stock of dry goods worth \$4500 for $\frac{2}{3}$ of its value?

3. At $\frac{3}{4}\%$, how much must be paid to an express company to insure the safe delivery of a package of silk worth \$800? If the package is lost, what amount will the express company pay to the sender?

4. Mr. Wilcox insures his house and barn for \$4000 at $1\frac{1}{4}\%$. If the property is destroyed, what is the loss to the insurance company?

5. A fire insurance company charged \$20 for insuring an automobile for \$1000. What was the rate of insurance?

6. At 2%, the premium for insuring a barn and its contents was \$24. Find the face of the policy.

7. What is the premium per \$100 at 1%? 2%? $1\frac{1}{2}\%$? $\frac{3}{4}\%$? $\frac{1}{8}\%$?

8. What is the cost per \$1000 at 60 cents per \$100? At 75 cents? At $87\frac{1}{2}$ cents? At \$1.25? At $1\frac{1}{2}$?

9. What is the rate per cent at \$1 per \$100? At \$2? At $1\frac{1}{2}$? At $\frac{3}{4}$? At \$2.50?

10. What is the rate per cent at \$100 per \$1000? At \$50? At \$10? At \$20? At \$25?

WRITTEN EXERCISE

Find the premium:

FACE OF POLICY	RATE	FACE OF POLICY	RATE
1. \$1750	$1\frac{1}{2}\%$	2. \$8500	$1\frac{1}{4}\%$
3. \$7500	$\frac{7}{8}\%$	4. \$13,500	$\frac{3}{4}\%$
5. \$6000	75¢ per \$100	6. \$4650	60¢ per \$100

Find the rate:

FACE OF POLICY	PREMIUM	FACE OF POLICY	PREMIUM
1. \$2800	\$35	2. \$3750	\$45
3. \$5600	\$35	4. \$6300	\$47.25
5. \$3400	\$51	6. \$3000	\$22.50

WRITTEN PROBLEMS

1. What is the premium for insuring a plate-glass window for \$250 at $\frac{3}{4}\%$?

2. The underwriters agree to insure a house for \$3500 for five years at $1\frac{1}{8}\%$. Find the premium.

3. The face of a policy is \$1800; the premium, \$22.50. What is the rate of insurance?

4. A farmer insured his house for \$2200 at $\frac{7}{8}\%$, and his barn and stock for \$1900 at $1\frac{1}{2}\%$. What was the premium?

5. Mr. Armstrong insures his house for \$3000 against fire for five years, paying a premium of \$22.50. Find the rate of insurance.

6. Mr. Lane insured his horse for \$850 at 60 cents per \$100. What was the premium?

7. What premium will insure the safe shipment of 600 barrels of flour worth \$5.80 per barrel if the rate is $\frac{3}{4}\%$?

8. A dealer in agricultural implements has a stock of goods worth \$15,000 which he insures for 80% of its value at $\frac{7}{8}\%$. Find the premium.

9. On May 1, 1910, Mr. Edward L. Blaisdell insured his house for \$2750 at $\frac{3}{4}\%$. On July 4, 1911, the house was burned. On July 30, 1911, the insurance company

sent a check to Mr. Baisdell for his insurance. What was the amount of the check? What was the loss to the company?

10. A storehouse is insured for \$12,000 in each of two companies. If the building is damaged by fire to the extent of $\frac{2}{3}$ of the insured value, how much ought each company to pay, one company being liable for two-thirds of the loss?

11. Mr. Quinn paid 75 cents to secure the safe delivery of a package in New York. If the rate was $\frac{3}{4}\%$, what value was placed on the package?

12. A cargo of wheat valued at \$7600, and insured for $\frac{3}{4}$ of its value at $2\frac{3}{4}\%$, was lost at sea. What was the loss to the owners? To the underwriters?

13. At $\frac{3}{4}\%$, Mr. Wilbur paid a premium of \$18 for insuring his property for $\frac{2}{3}$ of its value. Find the face of the policy. Find the value of the property.

14. A business block is insured for \$16,000 in one company, for \$18,000 in another, and for \$20,000 in a third. If the building is damaged by fire to the extent of 40 % of the insurance, what amount will each company pay to the owner?

LIFE INSURANCE

Written

1. Find the annual cost of a life-payment policy for \$5000, issued at age 30. (See table of rates on following page.)

2. If a man takes out a 20-payment life policy for \$5000, at age 30, what is the annual premium? How much will he pay in 20 years?

3. What is the annual premium on a 10-year term policy for \$10,000, at age 50?

TABLE OF LIFE INSURANCE RATES

Premiums per \$1000 Insurance. American 3% Reserve. Participating Plan.

Age	LIFE POLICIES Insurance payable at death only			ENDOWMENT POLICIES Insurance payable at end of term stated or at prior death		10-YEAR TERM POLICIES Insurance payable if death occurs within 10 years
	Premiums payable for			20 Years	30 Years	
	Life	20 Years	Single Payment			
20	\$18.01	\$27.60	\$366.20	\$47.01	\$30.46	\$11.05
25	20.14	29.90	394.30	47.52	31.14	11.60
30	22.85	32.65	427.00	48.25	32.17	12.35
35	26.35	36.00	465.10	49.32	33.78	13.50
40	30.94	40.17	509.10	51.03	36.38	15.35
45	37.08	45.53	559.50	53.84	40.59	18.55
50	45.45	52.70	616.20	58.52	47.31	24.10
55	56.93	62.55	677.80	66.15	57.60	33.35

To find semi-annual rates, multiply annual rates by .51. For quarterly rates, multiply annual rates by .26.

4. What is the annual cost of a 20-year endowment policy for \$3000, issued at age 25? How much will the insured pay in 20 years? How much less than the face of the policy will he pay?

5. Find the cost of a single-payment life policy for \$2500, at age 35?

6. What is the semi-annual premium for a life-payment policy for \$1000, at age 45? The quarterly premium?

7. Find the total cost of a 30-year endowment policy for \$5000, at age 25.

8. Find the total cost of a 20-year payment life policy for \$3500, at age 30.

ACCIDENT INSURANCE

Written

1. Mr. Shattuck owns a policy in Class A. He falls on the sidewalk and suffers total disability for 8 weeks. How much does the company pay him for loss of time? (See table of rates on following page.)

2. Mr. Aldrich sprains his ankle while going down cellar and suffers partial disability for 2 weeks 3 days. How much will the company pay him?

TABLE OF ACCIDENT INSURANCE RATES AND INDEMNITIES

Annual Cost, based on occupation: Class A, \$25; Class B, \$35; Class C, \$42.50; Class D, \$55

WEEKLY INDEMNITY FOR LOSS OF TIME

For TOTAL DISABILITY (paid during total disability).	For PARTIAL DISABILITY (paid for 30 weeks).
\$25.00 for Ordinary accidents.	\$12.50 for Ordinary accidents.
\$50.00 for Travel and Special accidents.	\$25.00 for Travel and Special accidents.

ACCIDENT INDEMNITIES

Paid IN ADDITION TO THE WEEKLY INDEMNITY

FOR ORDINARY ACCIDENTS	FOR TRAVEL OR SPECIAL ACCIDENTS
Paid if Assured is injured while engaged in the insured occupation, or in any of the ordinary duties or pleasures of life.	Paid if Assured is injured while passenger on railroad, steamboat, or elevator, by burning building, explosion, lightning, etc.

FOR LOSS OF

\$7,500	Life	\$15,000
\$7,500	Two Limbs	\$15,000
\$7,500	Both Eyes	\$15,000
\$7,500	One Limb and One Eye	\$15,000
\$3,750	One Limb	\$7,500
\$3,750	One Eye	\$7,500

3. Mr. Carter, insured in Class B, lost his arm by a boiler explosion, and was totally disabled for 32 weeks. Find his total indemnity.

TAXES

Towns, cities, counties, and states raise money to pay their expenses by means of a *tax*.

The people in town meeting or through their representatives determine what expenses shall be incurred, and the sum of money to be raised to meet them.

Taxes thus levied are chiefly of two kinds:

1. A *poll tax*. This is a tax levied directly upon an individual. In most states, every male citizen over 20 years of age is subject to this tax.

2. A *property tax*. This is a tax levied upon an individual's property.

For purposes of taxation, property is separated into two classes :

1. Property easily movable, such as money, stocks, bonds, furniture, cattle, etc. This is known as *personal property*.

2. Property not easily movable, such as lands, buildings, railroads, etc. This is known as *real property* or *real estate*.

Persons appointed to estimate the value of property for purposes of taxation and to determine the amount each person is to pay, are *assessors*.

The estimated value of the property on which the tax is to be levied is the *valuation*.

Property is usually estimated at a little less than its actual value.

The rate of taxation is always a certain per cent of the valuation.

If the amount to be raised is equal to .016 of the valuation, the rate is spoken of as 16 mills on a dollar, or \$1.60 on a hundred dollars, or \$16 on a thousand dollars, or $1\frac{7}{10}\%$ of the valuation.

1. A tax of $1\frac{7}{10}\%$ is what amount on \$1? On \$100? On \$1000?

2. What is the rate of taxation when the tax is \$2 per \$100? \$25 per \$1000? 18 mills per \$1?

The principles of percentage apply to problems in taxation.

The valuation is the whole or the base.

The tax to be raised is the part or the percentage.

The rate of taxation is the value of the part or the rate per cent.

WRITTEN PROBLEMS

1. In a certain city it is necessary to raise \$1,042,978 to pay the expenses for the year. The valuation of the real estate is \$39,765,200, and the valuation of the personal estate is \$15,578,800. There are 23,393 polls assessed at \$2 each. Find the rate of tax to be assessed on the property.

SOLUTION

\$1,042,978 = tax to be raised

46,786 = tax raised on 23,393 polls at \$2 each

\$996,192 = tax to be raised on property

\$39,765,200 = valuation of real estate

15,578,800 = valuation of personal estate

\$55,344,000 = total valuation

Tax to be raised, \$996,192, divided by the valuation, \$55,344,000, gives the rate.

$$.018 = .01\frac{1}{2} = 1\frac{1}{2}\%$$

\$55,344,000) \$996,192.000

That is, the rate of taxation is $1\frac{1}{2}\%$. This is 18 mills on \$1, \$1.80 on \$100, \$18 on \$1000.

2. The total valuation of a town is \$800,000. The amount to be raised is \$12,000. What is the rate of taxation? What is the tax on \$1000?

3. The value of the real property is \$2,450,000; the value of the personal property is \$3,750,000. It is necessary to raise \$74,400. What rate must be declared?

Find the rate of taxation, and the tax per \$1000:

	VALUATION		TO BE RAISED BY TAX ON PROPERTY
	Real Estate	Personal Estate	
4.	\$560,000	\$340,000	\$7,200
5.	\$980,000	\$670,000	\$26,400
6.	\$7,840,000	\$3,520,000	\$204,480
7.	\$48,000,000	\$23,000,000	\$1,065,000

8. The sum of \$380,512 is to be raised in a town where there are 2456 male citizens above 20 years of age. If each poll is assessed \$2, what amount is to be raised on property?

Find the rate of taxation:

	VALUATION		TAX TO BE RAISED	POLLS ASSESSED AT \$2 EACH
	Real Estate	Personal Estate		
9.	\$600,000	\$136,000	\$10,498	97
10.	\$820,000	\$2,450,000	\$26,394	117
11.	\$16,000,000	\$27,000,000	\$594,900	7,200
12.	\$72,000,000	\$36,000,000	\$1,870,494	17,247

13. Mr. White owns property valued at \$7800. Find his tax if the rate is $1\frac{7}{10}\%$ on property, and he pays a poll tax of \$2.

14. If every poll is assessed \$2, what is the total tax of a man whose real estate is assessed at \$4400 and personal estate at \$3600, in a town where the tax rate is \$12.50 per \$1000?

15. The assessors estimate Mr. Fay's property as follows: bonds, \$1200; house, \$3600; 10,000 square feet of land at 20 cents per square foot. Find the total valuation. Find Mr. Fay's tax if the rate of taxation is \$16.50 per \$1000.

NATIONAL TAXES

Our government raises the money necessary to pay its expenses in these ways:

I. By a tax on the right to make or sell liquors, tobaccos, patent medicines, etc. This is known as *internal revenue*.

II. By a tax on goods imported from foreign countries. This is known as *customs revenue* or *duties*.

III. By a corporation tax on the net profits of corporations when such profits exceed five thousand dollars.

A *tariff* is the list of the rates of duty placed by the government on imports.

Imported goods are classified as follows:

(1) On the *free list*; that is, exempt from duty.

For example, coffee, cotton seed, sugar beet seed.

(2) Subject to a *specific duty*; that is, a duty based on the number, quantity, weight, etc., of the goods without reference to value.

For example, the duty on pineapples is \$8 per 1000; on barley, 30¢ per bushel; on hay, \$4 per ton.

(3) Subject to an *ad valorem duty*; that is, a duty based on the value of the goods in the country where purchased.

For example, the duty on agricultural implements is 15% of their value.

(4) Subject to both a *specific* and an *ad valorem* duty.

For example, the duty on rugs is 10 cents per square foot and 40 % of their value.

Imported goods must be brought to certain designated places known as *ports of entry*, where the government maintains a *custom house* for the purpose of collecting duties.

A statement or inventory of the kind, quantity, and value of imported goods is a *manifest* or an *invoice*.

Allowance made for weight of barrels, casks, packing cases, etc., is *tare*.

Allowance made for liquids lost from barrels, bottles, etc., is *leakage* or *breakage*.

SCHEDULE OF DUTIES, 1913, ON CERTAIN IMPORTS

Automobiles (valued at less than \$2000)	30 % ad valorem
Barley	15 ¢ per bu. of 48 lb.
Drugs	10 % ad valorem
Leather, manufactures of	30 % ad valorem
Marble, manufactures of	45 % ad valorem
Oranges	$\frac{1}{2}$ ¢ per lb.
Perfumery	40 ¢ per lb., and 60 % ad valorem
Rice (cleaned)	1 ¢ per lb.
Sheep	10 % ad valorem
Toys	35 % ad valorem
Umbrellas	35 % ad valorem

VALUES OF A FEW FOREIGN COINS

COUNTRY	MONETARY UNIT	VALUE IN U. S. MONEY
England	Pound (£)	\$4.8665
France	Franc	\$0.193
Germany	Mark	\$0.238
Italy	Lira	\$0.193

The principles of percentage apply to problems in duties.

The value of the goods is the whole or the base.

The duty is the part or the percentage.

The rate of duty is the value of the part or the rate per cent.

WRITTEN PROBLEMS

1. Find the duty on 240 gallons of molasses at 6¢ per gallon, with an allowance of 10 % for leakage.

SOLUTION

10% of 240 gallons = 24 gallons, leakage

240 gallons - 24 gallons = 216 gallons, net quantity

$\$0.06 \times 216 = \12.96 , duty

In reckoning specific duties, allowances for tare, leakage, etc., are made before duties are computed.

2. Find the duty on a case of glassware bought in Germany for 715 marks, the rate of duty being 60 % ad valorem.

SOLUTION

$\$0.238 =$ value of 1 mark

$\$0.238 \times 715 = \170.17 , value of importation

60 % of $\$170 = \102 , duty.

Ad valorem duties are computed only on a whole number of dollars; less than 50 cents is rejected; 50 or more cents are counted as one dollar.

Using the table on page 344 for rates of duty, find the duty:

3. On 4 automobiles valued at \$795 each.
4. On a marble monument valued at \$1095.

5. On a case of 6 dozen umbrellas valued at 70 ¢ each.
6. On a 75-lb. case of drugs valued at 60 ¢ a pound; tare, 10 %.
7. On 2800 lbs. cleaned rice.
8. On 5 sheep costing £ 2 each in England.
9. On an importation of 48 lb. of perfumery valued at \$3.50 per pound.
10. On 25 dozen dolls (toys) costing 2 marks each in Germany.
11. On 60 gal. olive oil invoiced at 4 lire per gallon, the duty being 50 ¢ a gallon; leakage, 10 %.
12. What is the actual cost to the importer of a suit of clothes bought in England for £4 on which is paid an ad valorem duty of 40 %?
13. At 60 ¢ per square yard and 40 % ad valorem, what is the duty on a rug 15 ft. by 9 ft., costing in Germany 5 marks a square yard?
14. On a painting purchased in Italy for \$24,600, there was paid a duty of 20 %. The purchaser paid a premium of $2\frac{1}{2}$ % to insure safe delivery. Find the total cost.
15. Find the total cost of 720 yd. of Wilton carpet ($\frac{3}{4}$ yd. wide) bought at \$1.85 a running yard and subject to a specific duty of 60 ¢ a square yard and an ad valorem duty of 40 %.
16. What is the net weight of an importation of 50 cases of preserved fruits, each case containing 4 dozen 2-lb. jars, if an allowance of 20 % is made for tare? What is the duty at 1 ¢ per pound and 35 % ad valorem if the cost is 2 lire per pound?

17. On an importation of 120 pieces of silk lace of 40 yd. each, purchased in France at 5 francs per yard, an ad valorem duty of 60% was collected.

(a) Find the cost of the goods to the importer.

(b) The importer sold the goods to a dry goods firm at a profit of 25%. Find the importer's profit.

(c) The dry goods firm retailed it at a profit of 50%. Find the retail price per yard. (Give answer to nearest cent.)

18. An importation of 600 dozen pairs of stockings, valued at \$1.20 a dozen, pays a specific duty of 85¢ a dozen and an ad valorem duty of 15%. The importer makes a profit of $16\frac{2}{3}\%$, and the retailer a profit of 20%. Find the retail price per dozen pairs.

BASEBALL PROBLEMS

1. A baseball ground is 480 ft. by 360 ft. Its perimeter is what part of a mile?

2. Find its area in acres.

3. It is inclosed by a tight board fence 12 ft. high, supported by posts placed 10 ft. apart, to which are attached three 2" \times 4" stringers. The top of the fence is covered by a round rail. The posts cost 45¢ apiece; the stringers, \$32 per M; the boards, \$36 per M; and the rail, $2\frac{1}{2}$ ¢ a linear foot. Find the total cost of the lumber.

4. A championship game was attended by 5460 persons, each of whom paid an admission fee of 50¢ and 40% of whom paid 25¢ more for seats in the grand stand. Find the gross receipts.

5. Of the 5460 persons attending the game, $66\frac{2}{3}\%$ went by trolley, each paying a 5-cent fare both to and from the grounds. If the average cost to the railway company was $3\frac{1}{4}$ cents for each fare, find the net receipts of the company.

6. How many open cars of 13 seats each, 5 passengers to a seat, would be required to carry these persons to the game at one time, if each car carried $\frac{2}{3}$ more persons than its seating capacity?

FINAL STANDING AMERICAN LEAGUE — 1916

CLUBS	BOSTON	CHICAGO	DETROIT	NEW YORK	ST. LOUIS	CLEVELAND	WASHINGTON	PHILADELPHIA	GAMES WON
Boston .....	..	14	14	11	10	15	11	16	
Chicago	8	..	13	10	15	13	12	18	
Detroit	8	9	..	14	13	11	14	18	
New York	11	12	8	..	9	10	15	15	
St. Louis	12	7	9	13	..	11	10	17	
Cleveland	7	9	11	12	11	..	9	18	
Washington	11	10	8	7	12	13	..	15	
Philadelphia	6	4	4	7	5	4	6	..	
Games Lost									

7. Make a table showing the number of games won, the number of games lost, number of games played, and the standing in per cent of each club, expressing the per cent to the nearest tenth of a per cent.

8. A first baseman of the Clevelanders was credited with 1557 put outs, 105 assists, and 9 errors. How many chances had he? What per cent did he accept?

AMERICAN LEAGUE STATISTICS — 1916

CLUBS	TIMES AT BAT	RUNS	HITS	2-BASE HITS	3-BASE HITS	HOME RUNS	TOTAL BASES
Detroit	5199	670	1370	202	96	17	
Chicago	5088	601	1279	195	100	17	
Cleveland	5055	630	1264	231	67	16	
Boston	5028	550	1250	197	56	14	
New York	5198	577	1277	195	60	34	
St. Louis	5158	588	1262	181	50	13	
Washington	5124	536	1239	170	60	12	
Philadelphia	5010	447	1212	169	65	19	
Totals							

9. Find the total number of times at bat ; runs ; hits ; 2-base hits ; 3-base hits ; home runs.

10. Of the 1370 hits made by the Detroit team, 202 were 2-base hits ; 96 were 3-base hits ; and 17 were home runs. Find the total number of bases won by hits by the Detroit team. By each of the other teams.

11. The Detroit made 1370 hits in 5199 times at bat. Find their batting per cent.

12. List the clubs according to batting per cent.

OPENING AN ACCOUNT WITH A BANK

A person opening an account with a bank first gives his signature to the bank, in order that his orders for payment may be identified.

He then receives a *bank book* in which his deposits may be entered, and a *check book* filled with blank orders on the bank, each of which is attached to a *stub*, on which a memorandum of each order may be kept.

STUB	CHECK
\$ _____ Date _____ 191____ Pay _____ _____ _____ No. <u>2782</u>	The Union No. <u>2782</u> National Bank of New York New York, N.Y. _____ 191____ Pay to the order of _____ \$ _____ Dollars 100

A *deposit slip* is handed in with each deposit.

DEPOSITED IN THE		
UNION NATIONAL BANK		
OF NEW YORK		
BY <u>Stephen R. Morse</u>		
<u>May 16,</u> 191 <u>1</u>		
Please List Checks Separately		
	Dollars	Cents
<i>Bills</i> _____	<u>85</u>	_____
<i>Gold</i> _____	<u>40</u>	_____
<i>Silver</i> _____	<u>8</u>	_____
<i>Checks</i> _____	_____	_____
<i>6th Nat. Bank</i> _____	<u>18</u>	<u>75</u>
<i>Farmers' Trust Co.</i> _____	<u>34</u>	<u>12</u>
_____	<u>185</u>	<u>87</u>
_____	_____	_____
_____	_____	_____

CASHING A CHECK

The UNION NATIONAL BANK OF NEW YORK New York, N.Y., <i>May 19, 1911</i>	No. <u>221</u>
PAY TO THE ORDER OF <u><i>Arthur L. Arnold</i></u> \$ <u><i>247</i>^{<i>65</i>}/_{<i>100</i>} </u>	
<u><i>Two Hundred Forty-seven and</i></u> ^{<i>65</i>} / _{<i>100</i>} DOLLARS	
<i>Stephen K. Maxwell</i>	

When Mr. Arnold presents this check for payment, he *indorses* it, that is, orders it paid, by writing his name on the back. The bank then pays to him the sum named. Men in business usually deposit checks in the bank in which they keep their money, and the bank collects for them, placing the sums collected to their credit.

The *maker* of a check is the one who signs it.

The *payee* is the person to whose order it is payable.

The *face* of a check is the amount named.

Name the maker of the above check ; the payee ; the face.

Checks are usually indorsed in one of these ways :

(1) Indorsement in blank.

Arthur L. Arnold

When the person to whom the check is payable simply signs his name on the back, the indorsement is an *indorsement in blank*.

(2) Indorsement in full.

*Pay to the order of
George E. Frazer
Arthur L. Arnold*

If Mr. Arnold does not choose to draw the money himself, he may transfer the check to any other person, and the latter person may collect the sum

named. This is an *indorsement in full*.

The indorsement of a check should always be written across the back of the left-hand end:

A check containing the words "to the order of" or "or order," may be collected by the payee or by any person to whom he orders it paid. A check not containing the above words can be collected only by the person to whom it is payable.

WRITTEN EXERCISE

Using the name of some local bank, make out slips for the following deposits:

1. Bills, \$125; gold, \$80; silver, \$18.50; checks on Atlantic National Bank. \$48.76, \$38.21, and \$12.07.

2. Bills, \$245; silver, \$47.40; checks on Union Trust Co., \$184.67 and \$267.96; checks on Tenth National Bank, \$438.75 and \$305.12.

3. Bills, \$349; silver, \$29.75; checks on Farmers' Bank, \$69.37; Traders' Bank, \$184.78; Merchants' Bank, \$283.48; State Trust Co., \$107.29.

4. Mr. Richard S. Baxter makes the following deposits in one week:

April 15: bills, \$79; silver, \$17; checks \$29.37, \$48.56, \$5.27, \$15.28.

April 16: bills, \$200; checks, \$16.48, \$19.87.

April 17: checks, \$57.39, \$84.16, \$129.67.

April 18: bills, \$149; gold, \$120; silver, \$29; checks, \$43.75, \$12.17.

April 20: bills, \$47; gold, \$60; check, \$84.96.

April 21: bills, \$64; silver, \$17; checks, \$49.69, \$162.57, \$59.38.

Find the amount deposited for the week.

5. A merchant's balance on hand Sept. 12 was \$584.16. What amount had he to his credit after depositing \$27.42, \$58.27, \$86.25, \$19.58, \$112.68, \$8.40, \$2.97, and \$10.72?

6. For what amount can a merchant draw his check if he adds the following checks to his balance of \$251.18: \$148, \$56.50, \$102.84, \$96.78, \$237.54, \$317.29, \$208.49?

7. A bank account shows the following record: balance, \$86.45; deposits, \$27.84, \$19.50, \$37.75, \$58.25, \$125.89; withdrawals, \$20.15, \$134.69, \$27.30, \$42.18, \$40.92. Find the amount still on deposit.

8. Mr. G. H. Atkinson's balance on hand Feb. 12 was \$267.93. On Feb. 13 he deposited \$38.95, and paid by check a bill for 4 tons of coal @ \$7.50, less 4 %; on Feb. 15 he paid a plumber's bill of \$28.57, a grocery bill of \$19.45, a gas bill for 2400 cubic feet @ 35¢ per thousand cubic feet; on Feb. 16 he deposited a check for \$85.35, and paid an insurance premium of \$136.84. Find his balance on Feb. 17.

NOTE. Signing another person's name is *forgery*, a crime severely punished by law. Therefore, in making out checks and notes in your exercises, you must never sign the name of the supposed maker. You may, however, indicate the signature of the maker in this way: if Charles T. Walker is the maker, sign the note C— T. W—

Make out checks payable as follows, and show the proper indorsements :

9. Amount, \$29.64; payee, John F. Moran; maker, Edward S. Copeland; indorsement in blank.

10. Amount, \$127.25; payee, Bernard P. Sykes; maker, Charles R. Hill; indorsement in full to Henry R. Whitman.

11. Amount, \$32.50; payee, one of your schoolmates; maker, yourself; indorsement in full to one of your schoolmates.

12. Mr. Harry F. Ellis makes out a check for \$24 payable to the order of Edward T. Bingham, who makes it payable to the order of William G. Smith.

13. Mr. Edward T. Fitz makes a check for \$50 payable to the order of White & Co. White & Co. transfer it to George R. Jones. Mr. Jones deposits it to his credit in the Traders' Bank.

INTEREST

Interest is money paid for the use of money.

The principal is the sum of money for whose use interest is paid.

The rate of interest is the per cent of the principal paid each year for interest.

The time is the period on which the principal is at interest.

The sum of the principal and the interest is the amount.

Problems in interest are problems in percentage with the added element of time.

The principal is the whole or the base.

The interest is the part or the percentage.

The rate of interest paid each year for interest is the rate per cent.

1. Find the interest at 6 % on \$1284 for 4 months 17 days.

SOLUTION

\$0.02 = interest on \$1 for 4 months

.002 $\frac{1}{2}$ = interest on \$1 for 17 days

\$0.022 $\frac{1}{2}$ = interest on \$1 for 4 months 17 days

\$0.022 $\frac{1}{2}$ \times 1284 = \$29.318

Answer, \$29.32.

2. Find the interest at 6 % on \$3162 for 103 days.

SOLUTION

The pupil should learn by solving that the interest on any sum of money for *two* months or *sixty* days at 6 % equals .01 of the principal; for *six* days .001 of the principal.

103 days = 60 days + 30 days + 10 days + 3 days.

\$31.62, interest for 60 days

15.81, interest for 30 days ($\frac{1}{2}$ of interest for 60 days)

5.27, interest for 10 days ($\frac{1}{3}$ of interest for 30 days)

1.581, interest for 3 days ($\frac{1}{10}$ of interest for 30 days)

\$54.281, interest for 103 days

Find the interest:

	PRINCIPAL	TIME	RATE		PRINCIPAL	TIME	RATE
1.	\$640	60 da.	5 %	2.	\$880	90 da.	6 %
3.	\$370	45 da.	4 %	4.	\$760	75 da.	7 %
5.	\$980	15 da.	8 %	6.	\$824	72 da.	6 %

PRINCIPAL	TIME	RATE	PRINCIPAL	TIME	RATE
7. \$570	42 da.	7 %	8. \$890	48 da.	5 %
9. \$750	24 da.	6 %	10. \$650	36 da.	7 %
11. \$537	18 da.	5 %	12. \$498	66 da.	5 %
13. \$649	54 da.	4½ %	14. \$767	12 da.	6½ %
15. \$395	24 da.	7½ %	16. \$483	84 da.	5½ %
17. \$874	72 da.	4½ %	18. \$792	96 da.	4½ %
19. \$585	45 da.	6½ %	20. \$349	75 da.	5½ %

Find the amount:

PRINCIPAL	TIME	RATE	PRINCIPAL	TIME	RATE
1. \$320	28 da.	6 %	12. \$460	50 da.	6 %
3. \$280	34 da.	5 %	14. \$300	65 da.	7 %
5. \$820	43 da.	8 %	16. \$740	29 da.	4 %
7. \$624	57 da.	6 %	18. \$880	47 da.	5 %
9. \$952	19 da.	7 %	20. \$483	78 da.	4 %
11. \$837.50	25 da.	5 %	12. \$625.20	85 da.	6 %
13. \$369.75	46 da.	6 %	14. \$748.45	63 da.	7 %
15. \$413.38	92 da.	4½ %	16. \$806.57	76 da.	7½ %
17. \$235.76	38 da.	6½ %	18. \$722.64	58 da.	5½ %
19. \$642.29	67 da.	5½ %	20. \$953.92	44 da.	4½ %

SAVINGS BANK ACCOUNTS

Written

The following shows a savings bank account.

The interest term in this bank is 3 months, the quarter days being Jan. 1, Apr. 1, July 1, and Oct. 1. The rate of interest is 4%, compounded quarterly. The bank allows interest only on the smallest balance in each quarter. This interest is then added to the balance, thus creating a new principal for the succeeding quarter. This is said to be *compounding* interest. The bank reckons interest on even dollars only.

DATE		DEPOSIT		INTEREST		WITHDRAWN		BALANCE	
Jan.	1							156	72
Feb.	12	83						239	72
Mar.	3					25		214	72
Apr.	1			1	56			216	28
May	6					20		196	28
June	12	39						235	28
July	1			1	96			237	24

EXPLANATION. The first interest period is from Jan. 1 to Mar. 31. The smallest balance in even dollars during the period is \$156, and the interest, \$1.56 (1% of \$156), is added to the balance on Apr. 1. The next interest period is from Apr. 1 to June 30. The smallest balance in even dollars during the period is \$196, and the interest, \$1.96 (1% of \$196), is added to the account on July 1.

If the bank reckoned and compounded interest semi-annually, the depositor would be credited on July 1 with 2% on \$156—the smallest balance during the period from Jan. 1 to June 30—or \$3.12.

If the bank reckoned interest on quarterly balances and compounded semi-annually, the depositor would be credited on July 1 with 1% of the smallest balance for the first quarter plus 1% of the smallest balance for the second quarter.

1. Balance the following account, the rate being 4%:

(a) Interest reckoned and compounded quarterly.

(b) Interest reckoned and compounded semi-annually.

(c) Interest reckoned quarterly and compounded semi-annually.

DATE		DEPOSIT		INTEREST		WITHDRAWN		BALANCE	
Jan.	1							361	47
	20	284	76						
Mar.	11					45			
Apr.	1								
May	7	175	50						
June	1					60			
	25	100							

2. Balance this account, interest compounded quarterly at 4%: balance, July 1, \$356.93: deposits, Sept. 3, \$67.40; Sept. 19, \$253.76; Nov. 23, \$85: withdrawals, Oct. 30, \$65; Dec. 17, \$140.

FINDING THE RATE

Written

1. At what rate will \$400 earn \$72 in 3 years?

SOLUTION—

$\$0.03 =$ interest earned by \$1 in 3 yr. at 1%.

$\$0.03 \times 400 = \$12 =$ interest earned by \$400 in 3 yr. at 1%.

$\$72 \div \$12 = 6$, the rate per cent.

The rate at which a sum of money is at interest may be found by dividing the given interest by the interest earned by the given principal in the given time at 1 %.

2. At what rate will \$300 earn \$36 in 3 years?

3. Mr. Butler invested \$1200 in land and at the end of 2 yr. 6 mo. sold it at a profit of \$150. What annual rate of income did the investment yield?

4. A trust fund of \$25,000 yields an annual income of \$875. At what rate is it invested?

5. At what rate will a sum of money at simple interest double itself in 30 years? In 25 years? 20 years? $16\frac{2}{3}$ years?

6. In 60 days \$840 earned \$5.60. What was the rate?

Find the rate:

PRINCIPAL	INTEREST	TIME	PRINCIPAL	INTEREST	TIME
7. \$960	\$12	3 mo.	8. \$840	\$4.55	30 da.
9. \$750	\$13.75	4 mo.	10. \$720	\$5.40	60 da.
11. \$480	\$6.60	3 mo.	12. \$360	\$2.70	45 da.
13. \$690	\$8.05	2 mo.	14. \$540	\$6.75	90 da.

15. Mr. Atherton made two loans of \$1500 each, one for 60 days, the other for 90 days. Both netted the same return—\$15. What was the rate of interest received on each loan?

PROMISSORY NOTES

On May 24, 1911, Mr. Charles F. Walker buys goods to the value of five hundred dollars from James T. Springer. Not having the ready money to pay for them, Mr. Walker gives to Mr. Springer the following paper:

\$ 500 Chicago, Ill., May 24, 1911

Six months after date, for value received, I

promise to pay to the order of James T. Springer

Five Hundred Dollars,

with interest at 6%.

Charles F. Walker.

This paper is a *promissory note* or a *note*.

The essential features of this promissory note are as follows:

- | | |
|--|--------------------------------------|
| (1) At a certain place | Chicago, Ill. |
| (2) on a certain date | May 24, 1911. |
| (3) a certain person | Charles F. Walker. |
| (4) for value received | "for value received." |
| (5) promises to pay | "I promise to pay." |
| (6) at a certain time | "six months after date." |
| (7) to the order of a certain person | "to the order of James T. Springer." |
| (8) a certain sum of money | "Five Hundred Dollars," "\$500." |
| (9) with interest | "with interest at 6%." |

Interest-bearing notes may vary in form, but they must contain all of the above features.

The person who promises to pay is the *maker*, the *payor*, or the *promisor*.

Who is the maker in the above note?

The person to whom the promise is made is the *payee* or the *promisee*.

Who is the payee in the above note?

The person who holds or owns the note—either the payee or some person to whom the payee has sold the note—is the *holder*.

The sum of money named in the note is the *face* of the note.

To avoid mistakes, the face of the note is written twice — once in figures and once in words.

The date on which a note matures or becomes due is the *date of maturity*.

Compute the amount due at maturity on these notes :

1. \$480. DENVER, COLO., Jan. 18, 1911.

Thirty days after date, I promise to pay to the order of Henry S. Thomas, Four Hundred Eighty Dollars, with interest at 7 %.

Value received.

STEPHEN WHITNEY.

2. \$657. SEATTLE, WASH., Mar. 8, 1911.

Sixty days after date, I promise to pay Herbert M. Mason, or order, Six Hundred Fifty-seven Dollars, with interest at 6 %.

Value received.

ARTHUR R. JACKSON.

3. \$875. ST. LOUIS, MO., Dec. 20, 1910.

Four months after date, I promise to pay to the order of Walter S. Marsh, Eight Hundred Seventy-five Dollars, with interest at 5 %.

Value received.

JOHN L. STRONG.

4. \$1500. ALBANY, N.Y., Feb. 24, 1911.

Six months after date, I promise to pay Richard R. Waite, or order, Fifteen Hundred Dollars, with interest at 6 %.

Value received.

EDMUND M. PARKER.

5. \$1250. CLEVELAND, OHIO, April 9, 1911.

Three months after date, I promise to pay Samuel B. Copson, or order, Twelve Hundred Fifty Dollars, with interest at 7 %.

Value received.

SMITH B. RAINEY.

\$ <u> a </u>	<u> b </u>	, <u> c </u>	19 <u> </u>
<u> d </u> AFTER DATE <u> e </u> PROMISE TO PAY TO THE			
ORDER OF <u> f </u>			
<u> g </u>		DOLLARS,	
WITH INTEREST AT <u> h </u> %.			
VALUE RECEIVED.			
		<u> i </u>	

Blank forms like the above are generally used in making out notes.

Tell what is to be written in each of the spaces indicated by the letters *a* to *i*.

Study the form until you can write a note.

PROBLEMS

1. On Jan. 27, 1911, John Y. Peterson of New York bought goods to the value of \$840 from King and Cross, giving in payment therefor his note due in three months, with interest at 6 %.

Write the note.

What amount must Mr. Peterson pay when the note becomes due?

On what date must it be settled?

2. On Dec. 13, 1910, William K. Pond of Cleveland bought lumber worth \$486 of the Northern Lumber Co. Mr. Pond gave a written promise to pay in 4 months, with interest at 5%.

Write the promise.

When ought Mr. Pond to pay the note?

How much must Mr. Pond pay?

3. On Aug. 27, 1911, Arthur S. Walton of Trenton, N.J., bought \$1750 worth of coal from the Western Coal Co. Four hundred dollars was paid in cash, and a 10-days' note given for the balance, with interest at 7%.

Write the note.

Who is the payee in the note?

When should the note be paid?

How much was required to settle the note?

Make out notes from the following conditions, using the names of some friend as payee, and your own name as maker. Find the date of maturity, and compute the amount due on that date.

	FACE	DATE	TIME	RATE
4.	\$250	May 12, 1911	6 months	5%
5.	\$475	Dec. 3, 1910	4 months	7%
6.	\$693	Feb. 24, 1911	5 months	8%
7.	\$846	June 7, 1911	3 months	5%
8.	\$820	May 19, 1911	2 months	6%
9.	\$1272	Mar. 11, 1911	20 days	5%
10.	\$1436	June 7, 1911	30 days	5%
11.	\$1084	April 14, 1911	30 days	4%
12.	\$1327	Jan. 26, 1911	20 days	6%
13.	\$1728	Aug. 3, 1911	10 days	5%

14. \$350. LOUISVILLE, KY., July 24, 1912.

On demand after date, I promise to pay to the order of George R. Whiting, Three Hundred Fifty Dollars.

Value received, with interest at 7 %.

JACKSON S. PARKER.

This is a demand note and is due whenever payment is demanded.

Compute the amount due if payment was demanded on Sept. 30, 1912.

15. \$600. MONTGOMERY, ALA., Jan. 16, 1912.

Three months after date, we jointly and severally promise to pay to the order of Henry V. Berry, Six Hundred Dollars.

Value received, with interest at 8 per cent.

JOHN M. HARKINS.

CHARLES S. BAKER.

This is a joint-and-several note, and each signer is responsible for the whole amount due at settlement.

Compute the amount due "three months after date."

16. \$1200. KANSAS CITY, MO., Aug. 19, 1905.

Three months after date, we jointly promise to pay to the order of Lawrence S. Barker, Twelve Hundred Dollars.

Value received, with interest at 7 %.

ARTHUR B. SMITHSON.

GEORGE R. CARTER.

This is a joint note, and each signer is responsible for the payment of one half the amount due at settlement.

Compute the amount each must pay at the end of the time named.

Write notes complying with the following conditions and compute the amount due at settlement :

17. On Sept. 15, 1911, Mr. James O. Master of Fairfield, Ky., bought 6 cows at \$90 each from his neighbor, Mr. Henry R. Duncan. He paid down \$250, and gave a note due in 4 months with interest at 5 % for the balance.

18. Mr. Henry Q. Summers gave a demand note for \$6000 to Smith and Jackson on June 17, 1911, agreeing to pay interest at the rate of 8 %.

Payment was demanded Sept. 29, 1912.

19. Mr. Arthur B. Cady, who owns a fishing vessel worth \$4200, sells a three-sevenths interest to Horace C. Ridlon, accepting in payment a note due in 6 months with interest at 5 %.

20. Imagine that you and one of your playmates own a tract of land containing 15 acres. Buy his share at \$120 per acre; pay $\frac{2}{3}$ of the price down; and give a note for 60 days with interest at 6 % for the balance.

21. Mr. Burns buys at auction 6 lots of land, averaging 8000 sq. ft. each, at $7\frac{1}{2}$ ¢ per square foot, paying down \$25 on each lot and giving a note for the balance, due in 6 months at 5 %.

22. You sell a wood lot for \$800 to two parties, A. B. and C. D., who give a note due in 8 months with interest at 5 %. Write a note in which each is responsible for payment. A note in which each is responsible for payment of one half of the note.

BANK DISCOUNT

\$ 300 New York, N.Y., April 13, 1911

Sixty days after date I promise to pay to
the order of Baker F. Grant

Three Hundred Dollars

at the Union National Bank of New York.

Value Received.

Clark G. Runnals

On April 13, 1911, Mr. Clark G. Runnals buys goods of Mr. Baker F. Grant to the amount of \$300, giving the above note in payment. Mr. Grant, wishing to use at once the money represented by this note, asks a bank to buy it. The bank, being satisfied that both the maker and the holder are reliable persons, agrees to purchase it. After Mr. Grant indorses the note, the bank accepts it, and pays to Mr. Grant the sum named in the note less the interest for sixty days. $\$300 - \$3 = \$297$. This is *discounting the note*. The bank is now the owner of the note. When the note becomes due (60 days after April 13, or on June 12), Mr. Runnals must pay to the bank, instead of to Mr. Grant, the sum named in the note.

The sum deducted from the face of the note by the bank for its services is the *bank discount*.

Thus, \$3 is the bank discount on the above note.

Bank discount is simple interest on the value of a note when it becomes due, or *matures*.

The *value of a note at maturity* is its face value if non-interest-bearing; its face plus the interest for the time named if interest-bearing.

Thus, the value at maturity of a note for \$600 due in 60 days without interest is \$600; \$600 + \$6, or \$606, if bearing interest.

The amount paid by the bank for the note is the *proceeds* or *avails*; this is the value of the note at maturity less the bank discount.

Thus, \$297 is the proceeds of the above note.

The date when a note becomes due, or matures, is the *date of maturity*.

The date of maturity is found as follows:

(1) When a note is given for a specified number of months, the number of months is added to the date of the note.

Thus, a note for two months dated July 16 becomes due on the corresponding day of the second month after; that is, on Sept. 16. If dated July 31 and due in two months, the date of maturity is Sept. 30; that is, since there are not enough days in September to correspond with the thirty-first day of July, the note becomes due on the last day of September.

(2) When a note is given for a specified number of days, the exact number of days is added to the date of the note.

Thus, a note for 60 days dated Dec. 28 is due exactly 60 days after Dec. 28, or on Feb. 26.

The *term of discount* is the time from the date when the note is discounted until it becomes due.

Notes are quite generally discounted on the day made, but may be discounted at any time before maturity.

There is no uniform custom among banks in finding the term of discount. The method used by the larger banks, and followed in this text, is to count the exact number of days from the date of discount to the date of maturity.

In some states three extra days, called days of grace, are allowed before a note becomes legally due; and such days are added to the time named in the note in finding the date of maturity and in discounting. Since means of communication are now so abundant, days of grace have been abolished in most states. They are not regarded in this book.

Practice in finding the date of maturity and the term of discount, and in allowing days of grace, should conform to local customs.

If a note matures on a Sunday or a legal holiday, it is legally due in some states on the day preceding, in other states on the first business day following.

Since Saturday is a half holiday in banking circles, many banks in discounting notes due on that day extend the term of discount to the following Monday, but exact discount for the two additional days.

Banks discount only on whole dollars. If the cents named in the note are fifty or more, an extra dollar is counted; if less than fifty cents, the cents are neglected.

Thus, a note whose face is \$364.50 is regarded in discounting as \$365, while one whose face is \$364.49 is regarded as \$364.

Notes containing the words "to the order of," or "or order," are *negotiable*, and may be sold or transferred by the holder like any other property to another person.

When a note is sold or transferred, the seller, or holder, writes his name on the back. This is *indorsing* the note.

The person thus signing his name is the *indorser*, and his signature is an *indorsement*.

Notes, like checks, are usually indorsed in either of these ways:

IN BLANK

James T. Springer.

IN FULL

*Pay to the order of
Richard L. Mason.
James T. Springer.*

Every person indorsing a note in either of the above ways is responsible for its payment.

WITHOUT RECOURSE

*Without recourse.
James T. Springer.*

When the words "without recourse" precede the signature, the indorser is not responsible for payment.

FINDING DATE OF MATURITY

1. What is the date of maturity of a note for 3 months dated Aug. 17?

2. What is the date of maturity of a note for 90 days dated Aug. 17?

Either of these methods may be used.

- (1) 90, days to run
 14, remaining days in August
 76
 30, days in September
 46
 31, days in October
 15, days to run in November

Deducting 14 remaining days in August leaves 76 days; 76 days less 30 days in September leaves 46 days; 46 days less 31 days in October leaves 15 days. 15 days after Oct. 31 is Nov. 15.

- (2) Aug. 17 + 3 mo. = Nov. 17
 Nov. 17 - 2 da. = Nov. 15

90 days equals 3 months of 30 days each. 3 months after Aug. 17 is Nov. 17. Since August and October have 31 days each instead of 30, deduct 2 days from Nov. 17.

At sight, tell the date of maturity of these notes :

DATE	TIME	DATE	TIME
3. July 19	1 mo.	4. Jan. 29	1 mo.
5. Oct. 31	30 da.	6. Jan. 29	30 da.
7. May 17	2 mo.	8. Dec. 31	60 da.
9. June 28	60 da.	10. Dec. 31	2 mo.
11. Mar. 31	3 mo.	12. Dec. 30	90 da.
13. June 30	90 da.	14. Dec. 30	3 mo.
15. April 16	90 da.	16. July 25	60 da.
17. Oct. 30	4 mo.	18. Feb. 28	5 mo.
19. June 23	120 da.	20. Feb. 12	30 da.

NOTES DISCOUNTED AT DATE

1. \$2400. TOPEKA, KAN., July 19, 1911.

Ninety days after date, I promise to pay to the order of William Z. Sanborn, Two Thousand Four Hundred Dollars, at the Twelfth National Bank of Topeka.

Value received. .

EDGAR P. STIMSON.

Where is this note worth \$2400?

Why is it not worth \$2400 to-day (July 19)?

How much will the bank pay for it to-day, the rate of discount being 7%?

Find the date of maturity, bank discount, and proceeds of the following notes :

	FACE	DATE	TIME	RATE OF DISCOUNT
2.	\$240	Sept. 7	60 da.	6 %
3.	\$300	Nov. 12	30 da.	6 %
4.	\$120	May 26	3 mo.	5 %
5.	\$225	Apr. 5	45 da.	5 %
6.	\$180	Dec. 22	30 da.	6 %
7.	\$1200	Oct. 17	90 da.	8 %
8.	\$1800	Jan. 13	2 mo.	7 %
9.	\$2000	Feb. 20	4 mo.	5 %
10.	\$3000	June 18	30 da.	4 %
11.	\$1262.87	July 20	2 mo.	6 %
12.	\$1395.42	Sept. 30	3 mo.	6 %

NOTES DISCOUNTED AFTER DATE

1. Find the date of maturity and the term of discount of a note dated June 12, due in 90 days, and discounted July 24.

SOLUTION

June 12 + 90 da. = Sept. 10, date of maturity

July 24 to Sept. 10 = 48 da., term of discount

Find the date of maturity and the term of discount of the following notes :

	DATE OF NOTE	TIME	DATE DISCOUNTED		DATE OF NOTE	TIME	DATE DISCOUNTED
2.	Mar. 16	1 mo.	Mar. 28	3.	May 31	30 da.	June 8
4.	Feb. 20	2 mo.	Mar. 1	5.	April 18	60 da.	April 30
6.	Aug. 9	3 mo.	Sept. 12	7.	Aug. 6	90 da.	Oct. 1
8.	Jan. 25	4 mo.	Feb. 14	9.	July 8	60 da.	July 24
10.	Oct. 30	5 mo.	Dec. 15	11.	Feb. 21	30 da.	Mar. 1

Find the proceeds of these notes :

12. \$800. RICHMOND, VA., May 12, 1911.

Sixty days after date, for value received, I promise to pay to the order of Brown, Davis & Co., Eight Hundred Dollars.

JOHN A. MESSER.

Discounted April 8, at 6 %.

13. \$750. ALBANY, N.Y., Nov. 19, 1911.

Ninety days after date, for value received, I promise to pay to the order of Everett B. Payson, Seven Hundred Fifty Dollars, at the Hudson National Bank.

ARTHUR M. HOYT.

Discounted Jan. 16, 1912, at 7 %.

14. \$1200. SAN FRANCISCO, CALIF., June 8, 1911.

Three months after date, we promise to pay to the order of James C. Ropes, Twelve Hundred Dollars at the Union National Bank.

Value received

ROBERT L. SPENCER.

HARRY G. DAVIS.

Discounted July 12, at 5 %.

15. \$1500. MONTGOMERY, ALA., Feb. 16, 1911.

Sixty days after date, we jointly and severally promise to pay to the order of The Alabama Cotton Co., Fifteen Hundred Dollars at the Sixth National Bank.

Value received.

FORREST R. DALE.

CARL A. DEERING.

Discounted March 3, at 7 %.

Find the date of maturity, term of discount, bank discount, and proceeds of the following notes :

	FACE	DATE OF NOTE	TIME	DATE DISCOUNTED	RATE OF DISCOUNT
16.	\$879.45	May 19	60 da.	June 1	5 %
17.	\$338.84	July 24	90 da.	Aug. 30	6 %
18.	\$750	Jan. 24	3 mo.	Feb. 26	7 %
19.	\$1080	Oct. 27	4 mo.	Dec. 7	5½ %
20.	\$861.22	July 29	90 da.	Sept. 1	5 %
21.	\$371.75	Apr. 15	3 mo.	May 15	7 %
22.	\$480.40	May 25	2 mo.	June 15	6 %
23.	\$740.70	Jan. 20	60 da.	Feb. 24	6 %
24.	\$863.57	Apr. 1	1 mo.	Apr. 10	5 %
25.	\$326.83	July 24	2 mo.	Aug. 13	6 %
26.	\$3000	Aug. 1	30 da.	Aug. 19	5 %
27.	\$5000	Sept. 23	30 da.	Oct. 1	4½ %
28.	\$2500	Feb. 17	60 da.	Mar. 9	8 %

DISCOUNTING INTEREST-BEARING NOTES

1. Find the proceeds of the following note if discounted at date :

NEW YORK, N.Y., July 19, 1911.

Sixty days after date we promise to pay to the order of The Twentieth National Bank of New York, Two Thousand Dollars (\$2000), at said Bank, with interest at 6 %.
Value received.

JOHN DOE.

RICHARD ROE.

SOLUTION

$\$2000 + \20 (int. for 60 days) = $\$2020$, value at maturity

$\$2020 - \20.20 (int. on $\$2020$ for 60 days) = $\$1999.80$, proceeds

2. Find the proceeds of the above note if discounted Aug. 1.

3. Find the proceeds of the above note if discounted Aug. 4, the rate of discount being 5 %.

4. \$540. LOUISVILLE, KY., Dec. 12, 1911.

Sixty days after date I promise to pay to the order of The Planters Seed Co., Five Hundred Forty Dollars, with interest at 5 %.

Value received.

PRESTON G. LADD.

Discounted Dec. 24, at 7 %.

5. \$1800. KANSAS CITY, Mo., Sept. 14, 1911.

Four months after date I promise to pay to the order of Dennison and Page, Eighteen Hundred Dollars, with interest at 6 %.

Value received.

HORACE P. STILES.

Discounted Oct. 30, at 5 %.

6. \$980. SEATTLE, WASH., Feb. 4, 1911.

Four months after date I promise to pay to the order of The Pacific Bank, Nine Hundred Eighty Dollars, with interest at 6 %.

Value received.

HORACE G. PETERSON.

Discounted at date, at 6 %.

7. How much will a bank pay on June 1 for a note for \$400, dated June 1, payable in 90 days, with interest at 6 %, if the rate of discount is 6 %? How much if discounted July 2?

8. On April 15, 1911, Mr. R. S. Jackson buys a house from Mr. H. K. Mullins for \$3600, paying down $\frac{1}{3}$ of the price, and giving his note for the balance, payable in 6 months, with interest at 5%. Mr. Mullins discounts the note at date at 6%. Write the note and show the endorsement required by the bank. Find the proceeds. How much must be paid to cancel the note when it becomes due?

Find the proceeds of the following interest-bearing notes :

	FACE	DATE	TIME	RATE OF INTEREST	DATE OF DISCOUNT	RATE OF DISCOUNT
9.	\$480	Jan. 16, 1911	60 da.	6%	Feb. 8, 1911	6%
10.	\$765	Dec. 23, 1911	3 mo.	5%	Jan. 12, 1912	5%
11.	\$848	Aug. 29, 1911	90 da.	6%	Sept. 20, 1911	6%
12.	\$1050	April 5, 1912	4 mo.	5%	May 15, 1912	6%
13.	\$560	Sept. 11, 1912	1 mo.	6%	Sept. 17, 1912	7%
14.	\$2700	May 13, 1912	45 da.	5%	May 30, 1912	5%
15.	\$1680	Oct. 25, 1912	2 mo.	5%	Nov. 8, 1912	6%
16.	\$3260	Sept. 30, 1912	90 da.	5%	Nov. 3, 1912	5%
17.	\$2400	Feb. 7, 1913	60 da.	6%	Feb. 26, 1913	7%
18.	\$1880	Aug. 27, 1913	30 da.	6%	Sept. 8, 1913	6%

DICTATION EXERCISES

- $12 \times 9, + 2, + 11, \times 2\frac{1}{2}, + 7, + 4, + 9, \times 2, + 8.$
- $6 + 12, \times 3, + 9, \times 7, - 3, + 3, + 7, \times 6, + 8.$
- $22 \times 4, - 4, + 7, + 3, \times 8, + 60, \times 0, + 48, + 4.$
- $2\frac{1}{2} \times 12, + 2, + 4, \times 12, - 1, + 5, - 3, \times 4, + 16.$
- $11 \times 12, + 2, + 4, + 5, + 6, \times 3, + 6, \times 7, - 30.$
- $8^2 + 4, \times 5, + 4, + 7, \times 9, - 8, + 4, - 8, \times 3, + 9.$
- $7^2 - 1, + 6, + 7, \times 6, - 18, + 8, + 3, \times 12, + 6.$
- $\frac{1}{2}$ of 40, + 4, + 6, $\times 9, + 2, + 7, \times 8, + 6, + 2.$
- $\frac{1}{2}$ of $\frac{1}{2}, \times 20, + 4, \times 9, - 21, + 12, + 4, - 7, \times 3.$
- $\frac{3}{4}$ of $\frac{1}{5}, \times 60, + 6, + 7, \times 9, + 6, + 15, \times 25, - 4.$

STOCKS

Frequently several persons unite for the purpose of carrying on business, forming a *stock company*, and choosing a *board of directors* to manage its affairs. The law requires that a *certificate of incorporation* or *charter* must be secured from the state.

The *capital* or *stock* is divided into shares, usually of \$100 each.

Each person interested is a *stockholder* and receives a *stock certificate* showing the number of shares he owns and the par value of a share.

The *par value* of a share is its face value.

A stock share can be bought and sold like any other property, and its selling price is its *market value*.

The market value of a share of stock is rarely its face value. If the company is well managed and pays large dividends, the shares sell for more than their face value, since people can get a larger return for their money by buying the shares at a price higher than the face value than by investing their money in other ways. In like manner, the shares of a company poorly managed and paying small or no dividends are worth less than their face value.

When stock sells above its face value, it is said to be *above par*, or *at a premium*. Thus, a share selling for 108 means that a share whose par value is \$100 is worth in the market \$108; that is, it is \$8, or 8%, above par.

Similarly, when stock sells below its face value, it is said to be *below par*, or *at a discount*. Thus, a share selling for 95 means that a share whose par value is \$100 is worth in the market \$95; that is, \$5, or 5%, below par.

Profits are divided among the stockholders according to the number of shares each owns, and are called *dividends*.

ORAL PROBLEMS

1. If the net profit in one year of the company named in the stock certificate on page 375 is \$6000, what per cent dividend may it pay?
2. What dividend will Mr. Morrison receive on a share of stock? On his 20 shares?
3. At a commission of $\frac{1}{8}\%$ of the par value, how much will a broker charge for selling 1 share of stock whose par value is \$100? 2 shares? 6 shares? 10 shares? 20 shares? 50 shares? 100 shares?
4. If Mr. Morrison sells 10 shares of his stock through a broker at \$120 a share, how much will the purchaser pay for the shares? How much will the broker keep for his services in selling? How much will the broker pay over to Mr. Morrison?
5. What are Mr. Morrison's net receipts in selling 4 shares at \$90 a share, brokerage $\frac{1}{8}\%$?
6. How much will a broker charge Mr. Hatch for buying 10 shares of stock? If the stock is bought at \$120 a share, how much will Mr. Hatch pay for his 10 shares, including brokerage?
7. What is the cost of 10 shares of stock bought at \$80 a share, brokerage $\frac{1}{8}\%$?
8. How much does a broker receive for buying and selling 10 shares of New York Central railroad stock?
9. Mr. Terry receives quarterly dividends of $1\frac{1}{4}\%$ on his stock. What is the annual rate?
10. What is the rate of income when \$2 is received on stock bought at \$50?

STOCK QUOTATIONS, FEB. 25, 1911

<i>Railroads</i>	<i>Miscellaneous</i>
Atchison, Topeka, and Santa Fe 104½	Amalgamated Copper . . . 63½
Baltimore and Ohio . . . 103½	Am. Sugar 118½
Boston and Albany . . . 224	Am. Telephone and Telegraph 145½
Canadian Pacific 212	General Electric 152½
Denver and Rio Grande . . 32½	International Harvester . 116½
Illinois Central 134½	Puliman Car 159½
Louisville and Nashville . 144½	United Fruit 186½
New York Central 108½	U. S. Steel, common . . . 77½
Northern Pacific 123½	U. S. Steel, preferred . . 118½
Union Pacific 173½	Western Union 73½

BUYING THROUGH A BROKER

1. Find the cost of 12 shares of American Telephone and Telegraph stock, selling at 145½, brokerage ½ %.

SOLUTION

\$145.50, market price of 1 share

½ % of \$100 = \$0.12½, brokerage on 1 share

\$145.50 + \$0.12½ = \$145.62½, total cost of 1 share

\$145.62½ × 12 = \$1747.50, cost of 12 shares

2. How much must be paid for 42 shares of stock in People's Gas Co. at 103½, brokerage ½ %?

3. Mr. Adams directs his broker to buy 40 shares of Reading R. R. stock at the market rate. If the market rate is 153½, how much does Mr. Adams pay for the purchase?

Using the tables at top of page for prices, find the cost, including brokerage, of:

4. 25 shares of U. S. Steel, preferred.
5. 64 shares of U. S. Steel, common.
6. Make and solve ten examples similar to the above.

SELLING THROUGH A BROKER

1. Mr. Slater sent to his broker 46 shares of Illinois Central stock to sell at the market price. The broker sold at $134\frac{1}{4}$. How much did the broker remit to Mr. Slater?

SOLUTION

\$134.75, market price of 1 share

$\frac{1}{4}\%$ of \$100 = \$0.12 $\frac{1}{2}$, brokerage on 1 share

\$134.75 - \$0.12 $\frac{1}{2}$ = \$134.62 $\frac{1}{2}$, amount remitted on 1 share

\$134.62 $\frac{1}{2}$ \times 46 = \$6192.75, amount remitted on 46 shares

2. A broker sells for a customer 16 shares of New York Central stock at $107\frac{1}{2}$. How much does the broker retain for his services? How much does the customer receive?

Using the tables on page 377 for prices, find the amount remitted to the owner from the sale, through a broker, of:

3. 120 shares of Rio Grande.
4. 15 shares of Amalgamated Copper.
5. 29 shares of General Electric.
6. Make and solve ten problems similar to the above.

BUYING AND SELLING

1. Mr. Peterson bought 18 shares of General Electric at $143\frac{1}{2}$, and sold at $150\frac{1}{2}$, with brokerage at $\frac{1}{8}\%$ on both purchase and sale. How much did he make?

SOLUTION

\$143.62 $\frac{1}{2}$ + \$0.12 $\frac{1}{2}$ = \$143.75, cost of 1 share

\$150.50 - \$0.12 $\frac{1}{2}$ = \$150.37 $\frac{1}{2}$, selling price of 1 share

\$150.37 $\frac{1}{2}$ - \$143.75 = \$6.62 $\frac{1}{2}$, gain on 1 share

\$6.62 $\frac{1}{2}$ \times 18 = \$119.25, gain on 18 shares

2. Find the gain on 24 shares of American Woolen preferred stock bought at $87\frac{1}{2}$ and sold at $95\frac{1}{2}$, brokerage $\frac{1}{8}\%$
3. How much is made by buying 72 shares of New York, New Haven, and Hartford R. R. stock at $145\frac{1}{8}$ and selling at $150\frac{3}{4}$, brokerage at $\frac{1}{8}\%$?
4. Mr. Roberts bought and sold 27 shares of Excelsior mining stock, through a broker. At the time of buying, the stock was quoted at $117\frac{1}{4}$, and at the time of selling at $120\frac{5}{8}$. Find the gain.
5. Mr. Taylor instructed his broker to buy 50 shares of Union Pacific stock at the market rate, $173\frac{1}{8}$. A week later Mr. Taylor instructed his broker to sell at the market rate, $170\frac{3}{4}$. What was Mr. Taylor's loss?

FINDING THE RATE OF INCOME

1. What per cent of income is realized from investing in stock at 75 if the annual dividend rate is 3% ?

SOLUTION

3% of $\$100 = \3 , income on 1 share

$\$75 =$ cost of 1 share

$\$3 \div \$75 = \frac{3}{75} = .04$ or 4% , rate of income

2. Mr. Morgan buys a share of stock in a steel company at a premium of 20. The company pays 5% annually. Find the rate of income on the investment.

Disregarding brokerage, find the rate of income on:

3. A 4% stock bought at 80.
4. A 5% stock bought at a premium of 25.
5. A 5% stock bought at a discount of 25.
6. A $3\frac{1}{2}\%$ stock bought at $12\frac{1}{2}\%$ below par.
7. A $5\frac{1}{2}\%$ stock bought at 112.

8. What is the total cost of a share of stock bought through a broker when the market price is $79\frac{1}{8}$? What is the rate of income on the investment if the annual dividend rate is 4%?

9. Mr. Denton bought stock in a packing company quoted at $139\frac{1}{8}$, brokerage $\frac{1}{8}\%$; the rate of dividend paid by the company was 7%. Find the rate of income Mr. Denton received on his investment.

Reckoning brokerage at $\frac{1}{8}\%$, solve the following:

	MARKET PRICE	BROKERAGE ON 1 SHARE	COST OF 1 SHARE	RATE OF ANNUAL DIVIDEND	RATE OF INCOME ON INVESTMENT
10.	$49\frac{1}{8}$			3%	
11.	$159\frac{1}{8}$			8%	
12.	$89\frac{1}{8}$			3%	
13.	$119\frac{1}{8}$			6%	
14.	$107\frac{1}{8}$			9%	

INVESTING TO SECURE A SPECIFIED INCOME

1. What sum must be invested in a stock paying an 8% dividend annually to secure an income of \$1200 if the stock is purchased through a broker at $145\frac{1}{8}$?

SOLUTION

$$\$8 = \text{annual income from 1 share}$$

$$\$1200 \div \$8 = 150, \text{ number of shares}$$

$$\$145.62\frac{1}{8} + \$0.12\frac{1}{8} = \$145.75, \text{ cost of 1 share}$$

$$\$145.75 \times 150 = \$21,862.50, \text{ cost of 150 shares}$$

2. Mr. Gordon invests in 5% stock a sum sufficient to yield an annual income of \$800. How much must he send to his broker if the market rate is $107\frac{1}{8}$?

3. How much must be invested through a broker in a railroad stock paying semiannual 4% dividends and quoted at $147\frac{1}{4}$ to yield an income of \$600 every six months?

GIVEN THE AMOUNT INVESTED TO FIND THE NUMBER OF SHARES

1. How many shares of stock selling at $69\frac{1}{4}$ can be bought for \$1665, with brokerage?

SOLUTION

$$\$69.25 + \$0.12\frac{1}{4} = \$69.37\frac{1}{4}, \text{ cost of 1 share}$$

$$\$1665 \div \$69.375 = 24, \text{ number of shares}$$

2. Mr. Bartlett invested, through a broker, \$2862 in National Lead stock at $105\frac{1}{4}$. How many shares did he buy?

3. How many shares of stock at $97\frac{1}{2}$ can be bought for \$4692 if the brokerage is $\frac{1}{8}\%$?

4. Mr. Mixer sent his broker a check for \$3991.75 to cover the purchase of New Jersey Central railroad stock quoted at 285. How many shares did he buy?

COMMON AND PREFERRED STOCK

Sometimes companies issue two kinds of stock, *common* and *preferred*. Preferred stock is stock on which a specified rate of dividend is paid before any dividend is paid on the common stock. Preferred stock can never receive a dividend greater than the amount specified, while the amount of the dividend on common stock is limited only by the profits of the company.

1. What is the capital stock of a steamship company which issues 1500 preferred and 4500 common shares of a par value of \$100 each?

2. If the preferred stock of this steamship company draws 7 % dividends, and the common stock 5 % dividends, how much is paid in dividends in one year ?

3. A telephone company was organized with a capital of \$100,000, divided into 1000 shares of a par value of \$100 each. Of these 1000 shares, 300 were preferred shares on which 6 % dividends were to be paid, and 700 were common shares. The company paid in dividends \$4600. How much was paid on the preferred shares ? How much was left for the common shares ? What per cent was paid on the common shares ?

4. Mr. Storer owns 28 common shares and 9 preferred 6 % shares in the Parker Mfg. Co. Find the amount of his dividends in a year when the common stock pays $7\frac{1}{2}$ %.

5. Mr. Andrews received dividends to the amount of \$497 in one year on 17 preferred 7 % shares and 42 common shares in the Eclipse Copper Mining Co. What was the rate of dividend on the common stock ?

Find the amount paid in dividends under the following conditions :

	No. OF SHARES OF STOCK		RATE OF DIVIDEND ON	
	Preferred	Common	Preferred	Common
6.	200	800	7 %	$3\frac{1}{2}$ %
7.	250	750	6 %	5 %
8.	600	2400	$7\frac{1}{2}$ %	$4\frac{1}{2}$ %
9.	750	3000	5 %	8 %
10.	800	4000	$6\frac{1}{2}$ %	$7\frac{1}{2}$ %

Find the rate of dividend on the common shares under the following conditions:

	No. OF SHARES OF STOCK		AMOUNT OF DIVIDEND	RATE ON PREFERRED SHARES
	Preferred	Common		
11.	150	600	\$3600	6%
12.	350	1250	\$8700	7%
13.	400	1200	\$7000	7%
14.	550	1850	\$12,000	5%
15.	900	2700	\$26,100	8%

BONDS

National governments, states, counties, cities, towns, and corporations frequently borrow money, giving as security interest-bearing promises to pay called *bonds*.

Coupon bonds are bonds to which are attached interest certificates called coupons, which may be cut off and presented for payment annually, semiannually, or quarterly, as stated in the bond.

Registered bonds are registered on the books of the corporation in the name of the owner, and the interest when due is sent to the owner.

Interest on United States government bonds is payable quarterly.

Bonds are usually described by the name of the corporation issuing them, the rate of interest they bear, and the date when they become due. Thus, U. S. 2s 1930 means United States government bonds bearing 2 % interest, redeemable in 1930.

Bonds are like stocks except that they always bear a specified rate of interest, and both bonds and interest are payable at specified times.

Bond quotations are always given on the basis of \$100 par value. Thus, a bond quoted at $102\frac{1}{2}$ means that each \$100 of the face value sells for \$102 $\frac{1}{2}$. If the face value is \$1000, the bond is worth 10 times \$102 $\frac{1}{2}$, or \$1025.

Brokerage is always $\frac{1}{2}\%$ of the par value. Thus, the brokerage on a \$1000 bond is $\frac{1}{2}\%$ of \$1000, or \$1.25.

1. What is the market value of a \$1000 bond selling at 105 $\frac{3}{4}$?

2. Mr. Parker buys, through a broker, 10 one-thousand-dollar American Telephone and Telegraph bonds at 94 $\frac{1}{2}$. How much do they cost him?

3. (a) What is the annual income from 16 \$1000 Panama 2s?

(b) What are they worth at the market rate, 101 $\frac{1}{2}$?

(c) How much will the owner receive for them if he sells through a broker?

4. How much must be invested in \$1000 bonds paying 5% dividends to realize an annual income of \$2000 if the market value is 110?

5. Mr. Lane bought 8 \$1000 5% bonds of a railroad corporation at 120. What is his annual income from them? What per cent of income does he receive on his investment?

DIET PROBLEMS

Our food is composed of different substances: protein or the muscle-forming substance, carbohydrates (sugar and starch) which furnish warmth and energy to the body,

fat, mineral matter, and water. All of these are found in some articles of diet, only part of them in others. Milk has 3.3 % of protein, 5 % of carbohydrates, 4 % of fat, 87 % of water, and .7 % of mineral matter.

AVERAGE PER CENT OF FOOD SUBSTANCES IN SOME ARTICLES OF DIET. COMPILED FROM A REPORT OF THE U. S. DEPARTMENT OF AGRICULTURE

	PROTEIN	CARBO- HYDRATES	FAT	WATER	MINERAL MATTER
Bananas	1.2	22	.6	75.3	.9
Bread	9.2	53.1	1.3	35.3	1.1
Butter	1	—	85	11	3
Cheese	25.9	2.4	33.7	34.2	3.8
Chicken	22.6	—	2.2	74.1	1.1
Egg	14.8	—	10.5	73.7	1
Green peas	7	16.9	.5	74.6	1
Leg of mutton	18.5	—	18	62.5	1
Potatoes	2.3	18.3	.2	78.2	1
Rice	8	79	.3	12.3	.4
Roast beef	19.3	—	16.7	63.9	.9
Tapioca pudding	4.6	48.2	3.6	43.1	.5

1. Using the above table, find the number of ounces of protein, carbohydrates, fat, water, and mineral matter in :
(a) 1 lb. bread; (b) 1 lb. cheese; (c) 1 lb. chicken.

2. Find the cost of protein or muscle-forming substance in 10 lb. roast beef at 24¢ per pound.

3. What per cent of carbohydrates in gingerbread if 5.8 % is protein, 9 % fat, 18.8 % water, and 2.9 % mineral matter?

4. How much muscle-forming food in 2 dozen eggs if the average weight of each egg is 2 oz.? How much fat-forming food?

5. How much protein for each person in a dinner consisting of a 5-lb. leg of mutton, 2 lb. potatoes, 2 lb. green peas, 8 oz. bread, $1\frac{1}{2}$ lb. tapioca pudding, served to 8 persons?

6. Compare the amounts of carbohydrates in these two luncheons, and tell which should be chosen by a person who should eat little starchy food:

(1) Bread, 4 oz.; butter, 1 oz.; rice, 4 oz.; bananas, 4 oz.

(2) Chicken, 5 oz.; potatoes, 4 oz.; cheese, 2 oz.; tapioca pudding, 2 oz.

PARTITIVE PROPORTION

Oral

The separation of a number or a quantity into parts proportional to given numbers is *partitive proportion*.

1. Divide \$56 between two boys so that as often as one receives \$3 the other shall receive \$5.

$$3 + 5 = 8$$

$$\frac{3}{8} \text{ of } \$56 = \$21$$

$$\frac{5}{8} \text{ of } \$56 = \$35$$

When the first boy receives \$3, the other receives \$5; together they receive \$8. That is, the first receives \$3 out of every \$8, or $\frac{3}{8}$ of the amount distributed; the second, $\frac{5}{8}$.

Divide these numbers in the indicated proportions:

NUMBERS	PROPORTIONS	NUMBERS	PROPORTIONS	NUMBERS	PROPORTIONS
2. 14	4 to 3	3. 36	5 to 4	4. 27	4 to 5
5. 36	1 to 5	6. 60	7 to 8	7. 60	5 to 7
8. 45	2 to 3	9. 45	9 to 6	10. 48	5 to 11

11. Divide 45 cents between two boys so that their shares shall be to each other as $\frac{1}{4}$ to $\frac{1}{6}$.

$$\frac{1}{4} = \frac{5}{20}$$

$$\frac{1}{6} = \frac{4}{24}$$

Change the fractions to a common denominator.
Since the denominators are equal, the number is divided into parts proportional to their numerators.

$$5 + 4 = 9$$

Separate these numbers in the indicated proportions :

NUMBERS PROPORTIONS		NUMBERS PROPORTIONS		NUMBERS PROPORTIONS	
12.	20 $\frac{1}{2}$ to $\frac{3}{4}$	13.	30 $\frac{2}{3}$ to $\frac{4}{5}$	14.	28 $\frac{2}{3}$ to $\frac{5}{6}$
15.	30 $\frac{1}{3}$ to $\frac{1}{6}$	16.	45 $\frac{5}{12}$ to $\frac{1}{3}$	17.	40 $\frac{2}{3}$ to $\frac{3}{4}$
18.	42 $\frac{2}{3}$ to $\frac{1}{3}$	19.	36 $\frac{1}{2}$ to $\frac{1}{10}$	20.	84 $1\frac{1}{2}$ to 2

21. If a man divides his estate between his son and daughter in the proportion of 3 to 4, what part of the estate ought each to receive?

22. Divide 72 into three parts which shall be to each other as 3, 4, and 5.

23. Two boys buy a bat and a ball for 72 cents, one contributing $\frac{2}{3}$ as much as the other. How much does each contribute?

WRITTEN PROBLEMS

1. Separate 800 into parts proportional to 7 and 9.

2. Divide \$1000 between two people in the proportion of $\frac{1}{3}$ to $\frac{1}{4}$.

3. Separate 180 into two parts bearing the relation to each other of 3 to 7; $\frac{1}{2}$ to $\frac{1}{3}$; $\frac{1}{2}$ to $\frac{2}{3}$; 1 to $1\frac{1}{2}$; $1\frac{1}{2}$ to $2\frac{1}{2}$.

4. Separate 234 into parts proportional to 2, 3, and 4; into parts proportional to $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$.

5. A farmer raised 1150 ducks and chickens. The number of ducks was to the number of chickens as 8 to 15. How many ducks?

6. Divide \$225, the amount paid A and B for labor in building a house, if A worked 42 days and B $1\frac{1}{2}$ times as many days.

7. A and B agreed to do a piece of work for \$48. After working together 6 days, B was obliged to leave. A finished

the work in 4 days. How much did each receive for his labor?

8. A farmer on the prairies has two fields of a total area of 270 acres, one planted to corn and the other to wheat. The acreage of corn is to the acreage of wheat as 7 to 8. Find the number of acres in each field.

PARTNERSHIP

A union of two or more persons in business is a *partnership*.

The partnership is called a *company*, a *firm*, or a *house*. The money invested is the *capital*.

All gains and losses are shared by the members of the firm in proportion to the money each has invested.

ORAL PROBLEMS

1. Three farmers hire a man to reap and bind their wheat, the man furnishing machine and horses, at a total expense of \$120. It takes 5 days to reap the first field, 4 days for the second, and 3 days for the third. How much does each farmer pay?

2. Two boys in the manual training school built a motor boat. One furnished the materials and labor for the boat at an expense of \$20, the other furnished the materials and labor for the engine at an expense of \$40. They sold the boat for \$100. How did they divide the profit?

3. Two men hired a pasture for \$25. One pastured 4 horses for 5 weeks, and the other 3 horses for 10 weeks. How much ought each to pay?

HINT. 4 horses for 5 weeks is equivalent to 1 horse for 20 weeks.

WRITTEN PROBLEMS

1. Mr. Nason and Mr. Parker formed a partnership, Mr. Nason furnishing \$3000, and Mr. Parker \$5000. They gained \$2400. Find each partner's profit.

SOLUTION

Mr. Nason's capital = \$3000

Mr. Parker's capital = \$5000

Total capital = \$8000

Mr. Nason's share of capital = $\frac{3}{8}$

Mr. Parker's share of capital = $\frac{5}{8}$

Mr. Nason's gain = $\frac{3}{8}$ of \$2400, or \$900

Mr. Parker's gain = $\frac{5}{8}$ of \$2400, or \$1500

2. A and B engaged in business, A investing \$4500, and B \$6000. At the end of the year they divided a profit of \$2940. What was the share of each?

3. Mr. Spencer and Mr. Waldron shipped potatoes to the market together, Mr. Spencer shipping 240 bushels, and Mr. Waldron 420 bushels. The potatoes were sold for \$429. After deducting expenses of shipping and selling, amounting to 8 cents a bushel, what amount should each receive?

4. Two men in business one year earned \$6440 on a capital of \$10,400, of which one furnished \$5600, and the other the balance. Apportion the gain.

5. Three men formed a syndicate to purchase a tract of land for \$120,000. A put in \$34,000, B, \$40,000, C \$46,000. At the end of the year they were obliged to sell the land for \$100,000. What was the loss to each individual?

6. What is the share of each of three partners in a gain of \$3750, if the first and second invest equal capital, and the third as much as the first and second together?

7. The total gain was \$840. A's capital was \$1200, B's $\frac{1}{2}$ as much as A's, and C's $\frac{1}{2}$ as much as B's. What was each one's gain?

8. What amount of a capital of \$3900 was contributed by two partners whose profits were, respectively, \$480 and \$560?

9. What amount of the capital of \$4200 has each partner invested, if out of a gain of \$840 one receives \$520?

10. Five men hired a pasture for their cows for \$100, and paid \$15.50 for repairing the fences. What was each one's share of the total expense, if they pastured cows as follows: A, 5 cows for 10 weeks; B, 3 cows for 12 weeks; C, 4 cows for 9 weeks; D, 1 cow for 12 weeks; and E, 2 cows for 10 weeks?

11. A vessel costing \$9000, and insured for $\frac{4}{5}$ its value, was lost at sea. Apportion the insurance money among the owners, who owned 4, 3, and 2 shares, respectively.

12. Mr. Barnard, Mr. Sears, and Mr. White built a fishing vessel at a cost of \$13,000, contributing \$6000, \$4500, and \$2500, respectively, and agreeing to divide the profits after the vessel had made 25 trips. The vessel averaged 36,000 pounds of fish to a trip, for which was received an average price of \$2.75 per hundredweight. The expenses were \$6750; $\frac{4}{5}$ of the net receipts went to the crew, and $\frac{1}{5}$ to the owners. Find each owner's gain. This was what per cent of the investment? If there were 16 men in the crew, how much did each receive?

RATIO

Ratio is the relation of one number to another of the same kind.

Ratio is expressed by the sign : written between the two numbers, and is equivalent to the sign \div . Thus, the ratio of 8 to 4 is written $8 : 4$, and means $8 \div 4$, or 2.

The numbers compared are the *terms* of the ratio.

The first term is the *antecedent*, and the second the *consequent*. Thus, in the ratio $4 : 8$, 4 is the antecedent, and 8 the consequent.

The two terms taken together form a *couplet*.

At sight, tell the ratios :

- | | | | |
|---------------------------|--------------------------|--------------|--------------|
| 1. $4 : 5$ | 2. $12 : 60$ | 3. $24 : 8$ | 4. $54 : 9$ |
| 5. $15 : 25$ | 6. $36 : 27$ | 7. $15 : 45$ | 8. $49 : 56$ |
| 9. 30 cd. : 24 cd. | 10. 12 bu. : 15 bu. | | |
| 11. 1 bu. : 3 pk. | 12. 3 ft. : 12 ft. | | |
| 13. 1 yd. : 6 ft. | 14. 2 qt. : 10 pt. | | |
| 15. 6 qt. : 2 gal. | 16. 6 qt. : 1 pk. | | |
| 17. 20¢ : 75¢ | 18. 12 oz. : 1 lb. | | |
| 19. 800 lb. : 1 T. | 20. 75¢ : \$1.25 | | |
| 21. 2 yd. 2 ft. : 20 ft. | 22. 2 qt. 1 pt. : 4 gal. | | |
| 23. 3 pk. 4 qt. : 2 bu. | 24. 1 lb. 4 oz. : 2 lb. | | |
| 25. 2 hr. 30 min. : 1 da. | 26. 100 rd. : 1 mi. | | |

PROPORTION

Proportion is an equality of ratios. Thus, $8 : 4 = 6 : 3$, or $\frac{8}{4} = \frac{6}{3}$.

This means that the ratio of 8 to 4 (2) is equal to the ratio of 6 to 3 (2); or, that the quotient of $8 \div 4$ is equal to the quotient of $6 \div 3$.

The sign $::$ is sometimes used instead of the sign $=$ between the two ratios. Thus, $8:4::6:3$; and the proportion is read, 8 is to 4 as 6 is to 3.

At sight, test by comparing the ratios :

- | | |
|-------------------|----------------|
| 1. $6:3=14:7$ | 2. $3:6=6:12$ |
| 3. $12:2=18:3$ | 4. $3:2=9:6$ |
| 5. $3:8=6:16$ | 6. $3:15=5:40$ |
| 7. $9:12=12:16$ | 8. $5:8=10:16$ |
| 9. $10:12::15:18$ | 10. $3:6=6:12$ |

The first and the last terms of a proportion are the *extremes*, and the two middle terms the *means*.

In every proportion the product of the means equals the product of the extremes. Thus, in the proportion $8:4=6:3$, the product of the means (4×6), 24, equals the product of the extremes (8×3), 24.

11. At sight, test the proportions in examples 1 to 10 by comparing the product of the extremes with the product of the means.

Since the product of the means equals the product of the extremes, a missing extreme is found by dividing the product of the means by the given extreme.

Thus, in $8:4=6:?$

$$\frac{4 \times 6}{8} = 3$$

12. Find the missing mean in $8:?=6:3$.

13. Tell how to find a missing mean.

Find the missing terms:

- | | |
|-------------------|--|
| 14. $26:5=78:?$ | 15. $?:4=8\frac{1}{4}:5\frac{1}{2}$ |
| 16. $64:?=25:40$ | 17. $1\frac{1}{2}:2\frac{1}{2}=3\frac{1}{2}:?$ |
| 18. $7:35=? :285$ | 19. $8:128=? :64$ |

20. $? : 75 = 3 : 50$

21. $375 : ? = 225 : 12$

22. $7 : 12 = ? : 20$

23. $1 : 2 = 3 : ?$

24. $1 : \frac{7}{8} = ? : 56$

25. $? : 1\frac{1}{2} = 1\frac{1}{2} : 4$

26. $2 : \frac{3}{4} = \frac{3}{4} : ?$

27. $1 : \frac{2}{3} = ? : \frac{3}{4}$

28. $2\frac{1}{2} : 2\frac{2}{3} = ? : 18$

29. $5 : 2\frac{2}{3} = 8 : ?$

30. $9 : 12 = ? : 5$

31. $8 : ? = 5 : 5\frac{1}{2}$

32. $? : 15 = 15 : 60$

33. $\frac{1}{2} : \frac{1}{8} = \frac{1}{4} : ?$

34. Write a ratio equal to $12 : 4$. Express the equality of these ratios. Arrange the terms as in a proportion.

35. Write a fraction equal to $\frac{4}{5}$. Express the equality of these fractions, and arrange the terms as in a proportion.

36. What number has the same relation to 12 as $18 : 6$? Express this fact in a proportion.

37. Write two couplets whose ratios are 8. Express their equality.

38. Write a proportion the product of whose means is 48.

39. Write a proportion the product of whose extremes is 36.

WRITTEN PROBLEMS

1. If 12 tons of hay cost \$222, what will 14 tons cost?

SOLUTION

$12 : 14 :: 222 : ?$

7 37

$14 \times \frac{222}{12} = 259$

12

6

Ans. \$259.

Since the answer is to be in dollars, we make 222 the third term. It is evident that the same relation must exist between the cost of 12 tons and the cost of 14 tons as exists between 12 tons and 14 tons. Since 14 tons cost more than 12 tons, the first ratio must read $12 : 14$, because, if the fourth term is to be greater than the third term, the second term must be greater than the first.

2. If 26 yards of cloth cost \$39, what will 8 yards cost?

SOLUTION

$$26 : 8 :: 39 : ?$$

$$\begin{array}{r} 4 \quad 3 \\ 8 \times 39 \\ \hline 26 \end{array}$$

$$= 12$$

$$2$$

$$2$$

Since the answer is to be in dollars, we make 39 the third term. 8 yards will cost less than 26 yards. Since the fourth term is to be less than the third, the second term must be less than the first.

To solve problems by proportion :

Make that number the third term which is of the same kind as the required answer.

Of the two remaining terms, write the larger for the second term if the answer is to be greater than the third term, and the smaller for the second term if the answer is to be less than the third term.

Find the missing term, canceling when possible.

Proportion is simply another form of analysis, usually much shorter than the ordinary form. It is used largely in solving problems in geometry, physics, and chemistry.

3. A water meter registers 378 cubic feet in 27 days. At this rate, how many cubic feet will it register in 60 days?

4. The speeds of two automobiles are to each other as 8 to 15. If the rate of the slower is 20 miles per hour, what is the rate of the faster?

5. If 15 men can pave a street in 36 days, how many men must be employed to pave it in 18 days?

6. If a farmer receives \$40 for a pile of wood containing 6 cords, how much ought he to receive for 15 cords?

7. Mr. A's income from an investment of \$630 was \$30. Mr. B's income in the same transaction was \$50. Find his investment.

8. A farmer harvested 66 bushels of corn from a 4-acre field. How many bushels ought he to harvest from a 17-acre field?

9. How long ought a loan of \$750 to be kept to balance a loan of \$300 for 10 days?

10. A man owning $\frac{2}{3}$ of a building estimates the value of his share at \$27,400. At this rate, what is the value of $\frac{1}{3}$ of the building?

11. If a farmer's daughter exchanges 15 dozen eggs for 20 yards of cloth, how many dozen will be required to pay for 3 yards?

12. A camping party of 6 persons has provisions sufficient for 15 days. If 3 more persons join the party unexpectedly, how long can the outing last?

13. What is the height of a flagstaff casting a shadow 125 feet long, if a stick 10 feet long casts a shadow 6 feet long at the same time?

14. By applying the principle of proportion, find the height of various objects, such as the school building, telegraph poles, trees, etc.

POWERS AND ROOTS

4^2 means that 4 is to be used twice as a factor; 4^3 that 4 is to be used three times as a factor.

A product obtained by using a number as a factor a specified number of times is a *power*.

The product obtained by using the number as a factor twice is the *second power*; by using the number as a factor three times, the *third power*; and so on.

The *second power* of a number is its *square*; the *third power*, its *cube*.

The figure placed at the right and a little above the number is the *exponent*; it tells the power to be found.

1. Tell the second power, or square, of each of the numbers from 1 to 25. Of 30; 40; 50; 60; 70; 80; 90; 100.

2. Tell the third power, or cube, of each of the numbers from 1 to 12. Of 20; 30; 40; 50.

$(\frac{2}{3})^2$ means that $\frac{2}{3}$ is to be used as a factor twice. Thus, $\frac{2}{3} \times \frac{2}{3} = \frac{4}{9}$.

At sight, solve:

- | | | | | |
|-----------|------------|-----------------------|------------------------|-------------|
| 1. 1^5 | 2. 20^3 | 3. $(\frac{1}{2})^4$ | 4. $(2\frac{1}{2})^3$ | 5. $.1^2$ |
| 6. 2^4 | 7. 30^2 | 8. $(\frac{3}{4})^3$ | 9. $(2\frac{1}{4})^2$ | 10. $.5^2$ |
| 11. 5^3 | 12. 50^2 | 13. $(\frac{5}{8})^2$ | 14. $(1\frac{1}{2})^2$ | 15. 1.2^2 |

Using pencil, find the value of:

- | | | | | |
|------------|-------------|-------------|--------------|---------------------------------|
| 1. 28^2 | 2. 135^2 | 3. $.9^2$ | 4. $.07^2$ | 5. $(\frac{1}{2}\frac{1}{2})^2$ |
| 6. 75^2 | 7. 209^2 | 8. 1.8^2 | 9. 3.05^2 | 10. $(12\frac{1}{2})^2$ |
| 11. 36^3 | 12. 111^3 | 13. $.5^3$ | 14. $.05^3$ | 15. $(\frac{7}{16})^3$ |
| 16. 54^3 | 17. 202^3 | 18. 2.4^3 | 19. 2.03^3 | 20. $(8\frac{1}{2})^3$ |

One of the equal factors of a power is the *root* of the power.

One of the two equal factors of a number is the *square root* of the number; one of the three equal factors is the *cube root*. Thus, the *square root* of 64 is 8; the *cube root* of 64 is 4.

A root is indicated by the sign $\sqrt{}$, called the *radical sign*. Thus, $\sqrt{81}$ means the square root of 81; $\sqrt[3]{64}$ means the cube root of 64.

A small figure, called the *index*, written in the angle of the radical sign tells the root to be found. The sign without any index figure means the square root.

At sight, solve and test :

- | | | | |
|--------------------------|----------------------------|---------------------|-------------------------|
| 1. $\sqrt{1}$ | 2. $\sqrt{100}$ | 3. $\sqrt{144}$ | 4. $\sqrt{\frac{1}{4}}$ |
| 5. $\sqrt{.01}$ | 6. $\sqrt{36}$ | 7. $\sqrt{4900}$ | 8. $\sqrt{225}$ |
| 9. $\sqrt{\frac{9}{16}}$ | 10. $\sqrt{.04}$ | 11. $\sqrt{81}$ | 12. $\sqrt{6400}$ |
| 13. $\sqrt{256}$ | 14. $\sqrt{\frac{25}{36}}$ | 15. $\sqrt{.25}$ | 16. $\sqrt[3]{1}$ |
| 17. $\sqrt[3]{8}$ | 18. $\sqrt[3]{125}$ | 19. $\sqrt[3]{216}$ | 20. $\sqrt[3]{512}$ |
| 21. $\sqrt[3]{1000}$ | 22. $\sqrt[3]{64}$ | 23. $\sqrt[3]{27}$ | 24. $\sqrt[3]{343}$ |

SQUARE ROOT

1. Square 1 and 9 ; then 10 and 99 ; then 100 and 999.

$$1^2 = 1$$

$$10^2 = 100$$

$$100^2 = 10,000$$

$$9^2 = 81$$

$$99^2 = 9801$$

$$999^2 = 998,001$$

From the above table it will be seen that the square of any whole number of one figure consists of one or two figures ; the square of any whole number of two figures consists of three or four figures ; the square of any whole number of three figures consists of five or six figures, and so on. That is, the square of any whole number consists of twice as many figures, or one less than twice as many figures, as in the number itself. Hence, the number of figures in the square root of any number may be determined by beginning at units and separating the number

into periods of two figures each. Thus, the square root of $\overline{6724}$ consists of two figures: the square root of $\overline{17956}$ consists of three figures.

2. How many figures in the square root of 729? 2209?
11,664? 108,900? 640,000?

3. Find the square root of 1024.

$$\begin{array}{r} 32 \\ \overline{1024} \\ 9 \\ 62 \overline{)124} \\ \underline{124} \end{array}$$

(1) Beginning at units, separate the number into periods of two figures each.

(2) Find the greatest square in the left-hand period (10). The greatest square is 9. Write its root (3) over the period, and write the square (9) under the period.

(3) Subtract 9 from 10 and bring down the next period.

(4) Double the root already found and write the result at the left of the new dividend. $3 \times 2 = 6$. This is the trial divisor. Omitting the right-hand figure (4) of the dividend, find how many times the trial divisor is contained in 12. $12 \div 6 = 2$. Write 2 in the root, and also at the right of the trial divisor. 62 is the true divisor.

(5) Multiply the true divisor (62) by the last root figure (2). Since there is no remainder, the square root of 1024 is 32.

To find the square root of a number:

(1) *Beginning at units, separate the number into periods of two figures each.*

(2) *Find the greatest square in the left-hand period and write its root above it.*

(3) *Subtract this square from the period and bring down the next period.*

(4) *Double the root already found. Omitting the last figure of the dividend, divide the dividend by this number. Write the quotient in the root, and also at the right of the trial divisor.*

(5) *Multiply the true divisor by this last root figure.*

4. Find the square root of 30,625.

$$\begin{array}{r} 175 \\ \overline{)30625} \\ 1 \\ \underline{27} \\ 206 \\ \underline{189} \\ 1725 \\ \underline{1725} \end{array}$$

In case the number whose root is to be found consists of more than two periods, repeat the process used in finding the second root figure.

Find the square root of :

- | | | | |
|-------------|-------------|-------------|-------------|
| 5. 676 | 6. 841 | 7. 961 | 8. 1089 |
| 9. 1764 | 10. 2025 | 11. 2704 | 12. 2916 |
| 13. 5476 | 14. 6561 | 15. 7744 | 16. 9216 |
| 17. 19,600 | 18. 28,900 | 19. 48,400 | 20. 52,900 |
| 21. 10,404 | 22. 40,804 | 23. 42,849 | 24. 94,864 |
| 25. 207,025 | 26. 214,369 | 27. 278,784 | 28. 414,736 |

In separating a decimal into periods, begin at the decimal point and point off to the right. If the last period is not full, annex a cipher.

Thus, $\sqrt{.125} = \sqrt{.12 \ 50}$

In separating a whole number and a decimal into periods, begin at the decimal point and point off the whole number to the left and the decimal to the right.

Thus, $\sqrt{148.375} = \sqrt{148.37 \ 50}$

1. Find the square root of: (1) 436.81; (2) .2.

(1)
$$\begin{array}{r} 20.9 \\ \overline{)436.81} \\ 4 \\ \underline{409} \\ 36.81 \\ \underline{36.81} \end{array}$$

Since the trial divisor, 4, is not contained in 3, place a 0 in the root, annex a 0 to the trial divisor, 4, and bring down the next period.

$$\begin{array}{r}
 (2) \quad \begin{array}{r} .4 \ 4 \ 7+ \\ \hline .200000 \\ 18 \\ 84 \overline{)400} \\ \underline{336} \\ 887 \overline{)6400} \\ \underline{6209} \\ 191 \end{array}
 \end{array}$$

Annex as many 0's as may be necessary.

2. Find the square root of: (1) $\frac{144}{81}$; (2) $\frac{1}{4}$.

(1) $\sqrt{\frac{144}{81}} = \frac{12}{9}$ When both numerator and denominator are perfect squares, extract the root of each term.

(2) $\sqrt{\frac{1}{4}} = \sqrt{.142857} = .377+$ First change the fraction to a decimal.

3. Tell which of these numbers are perfect squares:

4000 400 40 4 .4 .04 .004 .0004

Find the square root of:

4. 3.24

5. 5.76

6. 6.76

7. 7.84

8. 30.25

9. 47.61

10. 51.84

11. 90.25

12. .01

13. .09

14. .36

15. .49

16. .0001

17. .0009

18. .0064

19. .0081

20. .0256

21. .0729

22. .0841

23. .0961

24. $\frac{81}{144}$

25. $\frac{186}{881}$

26. $\frac{186}{111}$

27. $\frac{225}{729}$

28. $\frac{1868}{1800}$

29. $\frac{2025}{2804}$

30. $\frac{1888}{2401}$

31. $\frac{4088}{1488}$

32. $2\frac{1}{4}$

33. $6\frac{1}{4}$

34. $30\frac{1}{4}$

35. $72\frac{1}{4}$

Find the square roots to the third decimal place:

1. 2

2. 3

3. 5

4. 7

5. 8

6. $\frac{1}{2}$

7. $\frac{1}{3}$

8. $\frac{1}{6}$

9. $\frac{1}{7}$

10. $\frac{1}{10}$

11. .2

12. .8

13. .03

14. .06

15. .12

16. 1.5

17. 3.4

18. 6.1

19. 8.2

20. 10.5

21. $1\frac{1}{8}$

22. $3\frac{1}{8}$

23. $4\frac{1}{8}$

24. $5\frac{1}{8}$

25. $8\frac{1}{8}$

PROBLEMS

1. What is the length of one side of a square wood lot containing $15\frac{1}{2}$ acres?

2. What is the distance around a square field containing 10 acres?

3. Mr. Morrison's house is 36 feet square, and stands in a square lot containing 9025 square feet. Find the area covered by the house. Find the length of the lot.

4. How many feet of picture molding will be required for a square room whose ceiling covers 256 square feet?

5. The entire outside surface of a cubical block is 1350 square inches. Find the dimensions of the block.

6. Find the dimensions of a square plate-glass window whose surface area is 56.25 square feet.

7. Mr. Draper's potato field is 147 feet long and 48 feet wide; his cornfield is a square of equal area. Find the dimensions of the cornfield.

8. A party of school children went on an excursion, paying \$12.25 for car fares. Each child's share of the expense was as many cents as there were children in the party. How much did each pay?

THE RIGHT-ANGLED TRIANGLE

In a right-angled triangle the side opposite the right angle is the *hypotenuse*. Thus, the line AC is the hypotenuse of the right-angled triangle ABC on page 402.

ABC is a right-angled triangle whose altitude, base, and hypotenuse are 3 inches, 4 inches, and 5 inches, respectively.

How many square inches in the square on the hypotenuse? In the square on the altitude? In the square on

Find the missing dimensions :

	ALTITUDE	BASE	HYPOTENUSE		ALTITUDE	BASE	HYPOTENUSE
1.	24 in.	?	26 in.	2.	?	192 ft.	200 ft.
3.	?	63 ft.	65 ft.	4.	$6\frac{3}{4}$ ft.	?	$9\frac{3}{4}$ ft.
5.	?	168 ft.	170 ft.	6.	?	90 yd.	106 yd.
7.	20 rd.	?	52 rd.	8.	?	104 ft.	130 ft.
9.	?	45 yd.	51 yd.	10.	$6\frac{1}{2}$ in.	?	13 in.
11.	22 in.	?	122 in.	12.	?	154 ft.	170 ft.
13.	?	110 ft.	146 ft.	14.	4 rd.	?	$8\frac{1}{2}$ rd.
15.	40 rd.	?	58 rd.	16.	$17\frac{1}{2}$ ft.	?	$18\frac{1}{2}$ ft.
17.	78 ft.	?	130 ft.	18.	?	$8\frac{3}{4}$ ft.	$9\frac{1}{4}$ ft.
19.	?	99 ft.	101 ft.	20.	$11\frac{1}{2}$ rd.	?	13 rd.

WRITTEN PROBLEMS

1. With a ladder whose foot was placed 14 ft. from a burning building the firemen were able to rescue a child at a window 48 ft. from the ground. How long was the ladder?

2. A 25-ft. ladder whose foot is 7 ft. from the base of the building just reaches the top of a flat-roofed building. How high is the building?

3. Mrs. Chase has a triangular flower bed in a corner of her rectangular house lot. The two short sides of the bed are 12 ft. and 16 ft. At $2\frac{1}{2}$ ¢ a foot, how much will it cost for wire netting for the third side?

4. A right-angled triangle has two equal sides; its hypotenuse is 16 in. Find the length of one of the other sides.

5. How many acres in a square field whose diagonal is 64 rd. ?

6. Mr. Blake has a square field of $2\frac{1}{2}$ A. What are its dimensions ?

7. A rectangular field 90 rd. by 48 rd. is separated into two parts by a path running diagonally through it. Find the length of the path. Find the number of acres in each part.

8. Arthur lives 48 rd. east of the schoolhouse, and Fred 55 rd. south of it. Arthur and Fred live how far apart ?

9. How long a throw is it from the home plate to second base on a baseball field 90 ft. square ?

10. The base of an isosceles triangle is 16 ft. and each of the other sides 17 ft. Find the altitude.

11. What is the altitude of an equilateral triangle each of whose sides is 20 ft ?

12. In going from one corner to the opposite corner of a field 56 rd. by 33 rd., how much is saved by going diagonally across the field ?

13. The pole of a circus tent is held in place by ropes 111 ft. long running from the top of the pole to stakes 105 ft. from the base of the pole. How high is the pole ?

14. The guy ropes of a derrick 28 ft. high are fastened to the ground 45 ft. from the foot of the derrick. How long are the ropes ?

15. A tree broken 12 ft. from the ground, but not detached, fell so that its top struck the ground 35 ft. from the foot of the tree. How high was the tree ?

REVIEW OF MENSURATION

TRIANGLES

Oral

1. What is a triangle?
2. Draw and describe a right-angled triangle. An acute-angled triangle. An obtuse-angled triangle.
3. Draw and describe an equilateral triangle. An isosceles triangle. A scalene triangle.
4. What is the altitude of a triangle?
5. How is the area of a triangle found?
6. What is the area of a triangle whose base is $6\frac{1}{2}$ ft. and whose altitude is 8 ft.?
7. What is the altitude of a triangle whose base is 5 in. and whose area is 40 sq. in.?
8. The perimeter of an isosceles triangle is 20 in.; its base is 6 in. How long is each of the other sides?

QUADRILATERALS

Oral

1. What is a quadrilateral?
2. Tell what name is given to quadrilaterals having
 - (1) two pairs of parallel sides.
 - (2) one pair of parallel sides.
 - (3) no two sides parallel.
3. Describe a rectangle. A square. A rhomboid. A rhombus.
4. How is the area of a parallelogram found? A trapezoid? A trapezium?

5. A window pane is 15 in. by 30 in. What is the lighting surface? Express its perimeter in feet.

6. The area of the top of a rectangular table is 10 sq. ft.; its width is $2\frac{1}{2}$ ft. Find its length. Its perimeter.

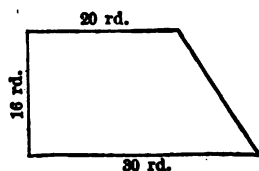
7. The parallel sides of a trapezoid, 8 in. and 12 in., respectively, are 6 in. apart. Find the area of the trapezoid.

WRITTEN PROBLEMS

1. How many acres in this field?

2. A rectangular field of equal area is 12 rd. wide. How long?

3. What are the dimensions of a square field of equal area?



4. The base of a triangular field of equal area is 40 rd. What is its altitude?

5. A man has two fields of trapezoidal shape, the altitude of each being 20 rd. The parallel sides of one are 60 rd. and 20 rd. The parallel sides of the other are 50 rd. and 30 rd. Find the number of acres in each field.

6. The diagonal of a trapezium is 36 ft., and the two perpendiculars from the angles opposite the diagonal are 19 ft. and 27 ft., respectively. What is the area of the trapezium?

CIRCLES

Oral

1. What is a circle?

2. Define radius. Diameter. Circumference.

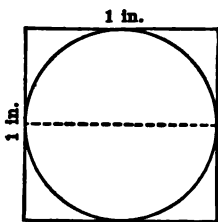
The ratio of the circumference to the diameter, 3.1416, is expressed by the symbol π , called pi (π).

3. When c represents the circumference, r the radius, d the diameter, and a the area, explain these statements:

$$(1) c = \pi \times d$$

$$(2) a = \frac{c \times r}{2}$$

4. Find the area of a circle 1 in. in diameter; of a square 1 in. long. By comparing the



area of the circle with the area of the square the area of the circle is found to be .7854 of the area of the square. Hence, the area of any circle may be found by multiplying the square of its diameter by .7854. This may be expressed as follows: $a = d^2 \times .7854$.

For approximate estimates π is regarded as $3\frac{1}{7}$; .7854 as $\frac{1}{8}$.

WRITTEN PROBLEMS

Find, approximately:

1. The length of the tire of a wheel 42 in. in diameter.
2. The diameter of a water main 44 in. in circumference.
3. The area of a circular window $17\frac{1}{2}$ in. in diameter.
4. The area covered in one revolution by a steam road roller 35 in. in diameter and 56 in. wide.
5. The capacity of a baking powder tin $1\frac{1}{4}$ in. in diameter and 7 in. high.
6. A restaurant coffee tank 15 in. in diameter and 22 in. high is half full. Find the number of gallons of coffee.
7. The convex surface of the tank in Problem 6 is of nickel. Find its area.
8. The front wheels of a wagon are 42 in. in diameter. The spokes of the hind wheels are 7 in. longer than the

spokes of the front wheels. How many times do the front wheels revolve in going 1 mile? The hind wheels?

Find, exactly:

9. The distance around a circle drawn with a 4-in. radius.

10. The diameter of a tree 55 in. in circumference.

11. The area of a circle drawn with a 7-ft. radius on the floor of a kindergarten.

12. The capacity in cubic feet of a cylindrical watering trough $2\frac{1}{2}$ ft. in diameter and 15 in. deep.

13. A circular wading pool in a park covers 7854 sq. ft. How far is it from the center to the shore?

14. How long is the shore line of the pool?

15. The shore line of a circular pond is 235.62 ft. John swims straight across the pond. What distance does he swim?

16. From the same center draw two circles, one with a 4-in. radius, the other with a 5-in. radius. Find the area of each. Cut out the smaller circle. What is the area of the circular ring left?

17. In the park is a circular flower bed 10 ft. in diameter surrounded by a gravel path 3 ft. wide. Find the area of the path.

18. The following are the dimensions of a cart wheel: hub, 8 in. in diameter; spokes, 1 ft. 8 in. long; rim, 2 in. thick. What is the length of a piece of iron required to make the tire?

MISCELLANEOUS ORAL PROBLEMS

1. The charge for a 3-minute telephone conversation between two places is 20¢, and 5¢ for each additional minute. Find the cost of a 6-minute conversation.
2. Six people hire an automobile for 8 hours at \$1½ an hour. What is each one's share of the expense?
3. Mrs. Green bought 16 yd. of gingham at 12½¢ a yard. How much did she pay for it?
4. Henry paid \$15 for a suit of clothes, .1 as much for a hat, and .01 as much for a collar. How much did he pay for each article?
5. Alfred spent 80¢ for a spelling book and an arithmetic, paying three times as much for the arithmetic as for the spelling book. How much for each?
6. When 16 oranges are sold for a quarter, what is the rate per dozen?
7. How long will it take a dressmaker to make a dress if she does .4 of the work in a day?
8. On a scale of 10 points for each of the ten problems given in a test, what is the mark of a pupil who solves the first three and the last four, fails on the fourth, solves one half of the fifth, and omits the sixth?
9. What is the cost of 1½ yd. of cloth at \$¾ a yard?
10. Ed can run around the square in 7½ min. and Joe in 6¾ min. If they start together, Joe will finish how much sooner than Ed?
11. What is the area of a lot 20 rd. by 5 rd.? How many rods of wire will be required to inclose it? How many posts set 1 rd. apart will be required to support the wire?

12. How many square yards of linoleum will be required to cover a floor 15 ft. by 12 ft. ?

13. At 50¢ per square yard, how much will it cost to lay a sidewalk 6 ft. wide and 60 ft. long ?

14. What is the cost of 5 cwt. of shorts at \$16 per ton ?

15. How many bookshelves 3 ft. long and 8 in. wide can be made from 3 boards 6 ft. by 16 in. ?

16. How many board feet in each board in the above example ?

17. A glove box is $7\frac{1}{2}$ in. long, 4 in. wide, and 3 in. deep. What is its capacity in cubic inches ?

18. Allowing 40 cu. ft. to a ton, how many tons of coal can be put into a bin 10 ft. \times 8 ft. \times 5 ft. ?

19. Reckoning $7\frac{1}{2}$ gallons to a cubic foot, how many gallons of water can be contained in a tank 2 feet square and 2 feet deep ?

20. What is the net cost of a bill of goods amounting to \$560, $12\frac{1}{2}\%$ off ?

21. When a merchant sells shovels at 80¢ each, he makes $33\frac{1}{3}\%$. Find the cost.

22. How many days from Oct. 22 to Nov. 7 ?

23. Mr. Whiting borrowed \$600 for 1 year at 5%. How much did he pay at time of settlement ?

24. What is the interest on \$3500 for 60 days at 6% ? For 6 days ?

25. When money is on interest at 5% a year, how long will it take to earn a sum equal to the principal ?

26. Mr. Hall spent 25¢ for postage stamps, buying twice as many two's as one's. How many of each kind did he buy?

27. Sarah marked off a piece of paper 6 in. \times 6 in., into inch squares. She then colored the outside row. Into how many squares was the paper divided? How many squares were colored?

28. A boy in the manual training class painted the surface of a 3-in. cube. How many square inches did he paint? He then cut the cube into inch cubes. How many did he have? How many of the inch cubes were painted on three sides? How many on two sides? How many on one side? How many were not painted at all?

29. What is the premium for insuring a house for \$3200 at $\frac{1}{2}\%$?

30. Mr. Burton insures his life for \$5000 at an annual rate of \$40.50 per \$1000. What is his annual premium?

MISCELLANEOUS WRITTEN PROBLEMS

1. A and B invested equal sums in a business costing \$4000. At the end of a year they estimated their stock to be worth \$6200, bills receivable \$1348, and cash in bank \$452. What ought either to give the other to secure the ownership of the business?

2. Mr. Parker hires a man and a boy on his farm at a yearly expense of \$480. The man receives \$25 a month. What part of the \$480 does the boy receive?

3. In 1909, vessels of a total tonnage of 15,407,527 passed through the Suez Canal and vessels of a total ton-

nage of 41,390,557 through the Sault Ste. Marie Canal. How much more tonnage through the latter canal?

4. Mr. Porter agreed to pay \$5760 for a farm supposed to consist of a certain number of acres. A survey showed that it contained 6 acres less than supposed. The owner then sold the farm to Mr. Porter for \$5472. How many acres in the farm?

5. The average weights and values of the several cuts of mutton from a flock of sheep were: leg, 22.2 lb. @ 10¢; loin, 17.5 lb. @ 9¢; rib, 14.5 lb. @ 9¢; chuck, 19.8 lb. @ 1½¢. Find the total value. The average price per pound for the carcass.

6. Mr. Jacobs intended to write to Mr. Donaldson that he would sell a pasture for \$540, at which price he would gain $\frac{1}{4}$ of the cost. By accident he wrote \$450. Mr. Donaldson bought the field at the price named. Did Mr. Jacobs gain or lose? What part of the cost?

7. Two ranchmen had 26,000 sheep each. One sold $\frac{1}{4}$ of his flock at one time and $\frac{1}{6}$ at another. How many had he left? The other sold $\frac{1}{4}$ of his flock at one time and $\frac{1}{6}$ of the remainder at another. How many had he left?

8. On March 1 Harry and James each had \$12 in the school savings bank. On April 1 Harry increased his deposit $\frac{2}{3}$, and on May 1 withdrew $\frac{2}{3}$ of his money. On April 1 James withdrew $\frac{2}{3}$ of his deposit, and on May 1 increased his deposit by $\frac{2}{3}$ of what he then had to his credit. How much had each then in the bank?

9. A man's estate was divided as follows: $\frac{1}{2}$ to his wife, $\frac{1}{4}$ of the remainder to his son, and the rest equally

between two daughters. Each daughter received \$4800. What was the value of the estate?

10. A provision dealer bought 40 chickens whose net weight was 175 pounds at $\$1\frac{1}{2}$ a pound. If the express charge was $1\frac{1}{2}$ ¢ a pound, how much did he gain by selling the chickens at an average price of \$1.05?

BETHLEHEM, N.H., Sept. 27, 1911.

MR. HERBERT R. LAWSON

Bought of JASON D. STAPLES

$\frac{1}{2}$ bbl. Flour	@	5.80				
25 lb. Sugar		.05 $\frac{1}{2}$				
4 bu. Oats		.56				
10 gal. Kerosene		.15				
Cr.						
By 13 doz. Eggs		.22				
" 16 lb. Butter		.24				
Balance due						

11. Complete the above bill, settlement being made in full on Oct. 12, 1911.

12. An acre of land bought for \$2250 was cut up into lots 110 ft. \times 66 ft., which sold for \$1210 each. What was the gain?

13. Find the value at \$18.50 a ton of the timothy hay in a mow 30 ft. by 28 ft. by $12\frac{1}{2}$ ft., reckoning 450 cu. ft. to a ton.

14. Mr. Harrison, a builder, contracts for 64,800 bricks, each 8 in. by 4 in. by 2 in. How many cars 30 ft. by 8 ft.

will be required to carry them, if they are piled 2 ft. high on the car?

15. How many tiles 2 in. square will be required for the hearth of a fireplace $3\frac{1}{2}$ ft. by $1\frac{1}{2}$ ft.?

16. How much must a grocer charge per bottle for olives, which cost him \$5.76 per case of 2 dozen bottles, to make 25% if the freight is 24¢ per case?

17. A merchant buys one grade of shoes at \$3.20 a pair and another grade at \$4 a pair. Which grade is it more profitable for him to sell if he makes 80 cents on each pair?

18. A milliner charged \$7.50 for a hat. She paid \$0.25 for the frame, \$3.40 for trimmings, and \$1 for labor. Find the per cent of profit.

19. Mr. A planned to sell his house for \$3575, which would allow him a profit of 10%. He sold it, however, for \$3225. Did he gain or lose? How much?

20. A dealer in farm supplies buys fertilizer at \$30 per ton and retails it at \$0.95 per 50-lb. bag. Find his gain per cent.

21. Find the amount of the following gas bill if paid on Nov. 17; if paid on Nov. 16.

Meter Readings	Nov. 7, '11	18,200 cu. ft.	
	Oct. 6, '11	14,500 cu. ft.	
Gas consumed at 11¢ per 100 cu. ft.		cu. ft.	\$
Discount at 2¢ per 100 cu. ft.			
Balance Payable			\$

Discount allowed if paid on or before Nov. 16.

22. A steel coal car 31 ft. long, 9 ft. 4 in. wide, and 7 ft. 6 in. high (inside dimensions) weighs 42,000 lb. and carries 50 T. Express its capacity in cubic feet, its weight in tons, and its load in pounds.

23. A schoolhouse lot is 12 rd. by 8 rd.

(a) What part of an acre is the lot?

(b) Trees are planted 33 ft. apart around the lot. How many?

(c) The schoolhouse is 90 ft. by 66 ft. What part of the lot does it cover?

24. When flooring is selling at \$60 per M, what is the cost of laying a floor 18' by 15', allowing $\frac{1}{10}$ for waste and \$7.75 for labor?

25. A water tank is 4 ft. long, 3 ft. wide, and 5 ft. deep. What will it cost to line it with zinc at 8¢ per square foot?

26. Simplify $\frac{\frac{2}{3} \text{ of } 3\frac{1}{2}}{\frac{2}{3} \text{ of } \frac{5}{8}} + \frac{2\frac{1}{2} + \frac{2}{12}}{3\frac{7}{12} - 2\frac{1}{3}}$.

27. The earth removed in digging a cellar 75 ft. by 36 ft. and 6 ft. deep was used in grading a lot 180 ft. by 135 ft. How many inches was the grade raised?

28. A hardwood border 18 in. wide is laid in a room 18 ft. by $16\frac{1}{2}$ ft. at a cost of 32¢ per square foot. The space within the border is covered by a rug. Find the cost of the border. Find the dimensions of the rug in yards.

29. The average yearly weight of fleece from Suffolk sheep raised at an agricultural experiment station was 7.65 lb. The shrinkage in scouring was 54%. Find the value at 24¢ per pound of the scoured fleece from 500 such sheep.

30. A merchant owing \$5245 paid 68 cents on a dollar. How much did he pay his creditors?

31. If a merchant buys a harness for \$18 and sells it for \$24, how much ought he to get for a harness costing \$30 to make the same per cent profit?

32. If the water pumped from a salt mine contains $17\frac{1}{2}\%$ of its weight of pure salt, how many pounds of the water will be required to obtain a barrel (280 pounds) of pure salt?

33. A dealer in automobiles received discounts of 25% and 10% on a machine listed at \$1600. He sold it at a net gain of 15%. Find the gain.

34. My agent sells for me a piece of land for \$2400, charging a commission of 5%. The balance gives me a profit of 20%. What did I pay for the land?

35. By error an importer was charged a duty of \$1350 on an importation valued at \$2250. The correct charge was 40% ad valorem. What was the sum returned by the government to the importer?

36. What will it cost at \$1 per rod to fence a field in the shape of a right triangle whose base is 70 rd. and whose altitude is 24 rd.?

$$37. \frac{\sqrt{144}}{\sqrt{81}} + \sqrt{256} = ?$$

$$38. \sqrt{51.84} \times \sqrt{12.25} - \sqrt{635.04} = ?$$

39. On goods costing \$120 a merchant made a profit of 40%, and yet pleased a customer by allowing a discount of 25%. How much did he ask for the goods at first? How much did he receive?

40. How many board feet in a $\frac{7}{8}$ -in. board 12 ft. long, 16 in. wide at one end, and 12 in. wide at the other end?

41. What is Mr. Atkinson's tax if the rate is \$18 per \$1000, and he pays a poll tax of \$2, \$3.25 for street watering, owns real estate valued at \$6400, and personal property valued at \$12,800?

42. The valuation of Mr. Bacon's property is \$6600, and the tax rate \$17.50 per \$1000, with a discount of 2% for prompt payment. How much can he save by paying promptly?

43. When 8% preferred stock is bought at 165, what is the per cent of income on the investment?

44. When the shares in a stocking manufacturing company paying 6% dividends are quoted at 125, Mr. Moore invests \$500. At the same time he loans \$500 on a mortgage at 5%. What income does he receive on each investment in a year?

45. Through a broker, a man bought 35 shares of a certain stock at $5\frac{1}{2}\%$ below par, and sold it two weeks later at $7\frac{3}{4}\%$ above par. What was his profit?

46. Change $\frac{42560}{88880}$ to lowest terms, and change the resulting fraction to a decimal.

47. Change $\frac{2\frac{1}{2} \times \frac{3}{8} \div \frac{3}{4}}{1\frac{1}{2} \div \frac{1}{18}}$ to a decimal.

48. How many cubic feet in a log 20 ft. long and 10 in. in diameter?

49. What is the waste in cubic feet in turning a column 6 ft. long and 6 in. in diameter from a stick of timber 6 ft. long and 6 in. square?

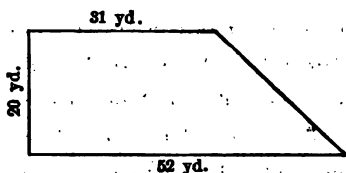
50. A tin dish 8 in. by 6 in. was filled to a depth of $1\frac{1}{2}$ in. in a rainstorm. How many cubic inches of rain fell to a square foot?

51. A cake of ice 2 ft. square floating in the river stands $2\frac{1}{2}$ in. above the water. If $\frac{8}{9}$ of the cake is submerged, what is the volume of the cake in cubic feet?

52. Two trains start from the same station, one at the rate of 28 mi. and the other 45 mi. per hour. How far apart will they be in 6 hr.:

- (a) If they go on parallel tracks due east?
- (b) If one goes due east and the other due west?
- (c) If one goes due east and the other due north?

53. Find the perimeter of this lot.



54. Find its value at 16¢ a square foot.

55. A disabled steamer sends a wireless call for help at 4 o'clock, P.M., giving her longitude as 64° W. The message is picked up immediately by another steamer in the same latitude whose longitude is $62\frac{1}{2}^{\circ}$ W. Reckoning a degree of longitude as 63 mi., at what time will the second steamer, going 18 knots an hour, reach the one in distress? (A knot is $1\frac{1}{2}$ mi.)

56. The call sent by the steamer in problem 55 is heard by another steamer 60 mi. west and 45 mi. north of the disabled steamer. At what time will this steamer, going 18 mi. an hour, reach the one in distress?

57. Find the interest at 5% on \$2384 from April 16 to Sept. 3.

58. Find the proceeds of a note for \$2763 for 60 days,

dated Feb. 20, 1911, and discounted on Mar. 16, 1911, at 7 %.

59. How many yards of ribbon $\frac{1}{4}$ in. wide will be required to tie 24 boxes of candy, each 6 in. long, 4 in. wide, and 3 in. high, if the ribbon goes around the box once each way, and 8 in. are allowed for the knot?

60. At an election for president of a debating society, John received 27 votes and James 63 votes. What per cent of the votes cast did James receive?

61. A butter dealer makes a contract to furnish a customer a special brand of butter at 27¢ per pound the year round. If for 3 mo. the market rate is 32¢, for 3 mo. 22¢, for 3 mo. 28¢, for 2 mo. 27¢, and for 1 mo. 25¢, does the customer, who uses 15 lb. per month, gain or lose by the contract? How much?

62. A pipe discharges 6 gal. of water per second. How long will it take to fill a tank 7 ft. by 3 ft. by $3\frac{1}{2}$ ft.?

63. A fruit dealer bought a bunch of bananas, containing 15 dozen, for \$1.80. Twenty per cent ripened too fast and had to be thrown away. Twenty-five per cent of the rest he sold at the rate of 2 for 5¢, and the remainder at the rate of 15¢ a dozen. Find his per cent of profit.

64. Five men contributed equally the \$80,000 necessary to build a business block. The total receipts the first year were \$12,200. The expenses were: insurance, $\frac{3}{4}$ of the value of the building at $\frac{1}{4}$ %; taxes, \$16.50 per thousand on a valuation of \$70,000; janitors' services, \$1380; other expenses, \$1615. What income did each owner receive? What per cent on his investment?

REFERENCE TABLES OF MEASURES

COUNTING

12 things = 1 dozen (doz.)
 12 dozen = 1 gross (gr.)
 12 gross = 1 great gross
 20 things = 1 score

PAPER MEASURE

24 sheets = 1 quire
 20 quires = 1 ream
 500 sheets are frequently called
 a ream
 Paper is quite generally sold by
 the pound

LONG OR LINEAR MEASURE

12 inches (in.) = 1 foot (ft.)
 3 feet = 1 yard (yd.)
 5½ yards
 or
 16½ feet } = 1 rod (rd.)
 320 rods = 1 mile (mi.)
 1 mi. = 320 rd. = 1760 yd. = 5280 ft. = 63,360 in.

½ inch = a size, used by
 shoemakers
 3 inches = a palm
 4 inches = a hand
 9 inches = a span
 18 inches = a cubit
 2½ feet = a military pace
 3.3 feet = a pace

6 feet = a fathom
 120 fathoms
 or
 720 feet } = a cable length
 1.15+ miles = a geographical
 mile; a nautical
 mile, or a knot
 3 nautical miles
 or knots } = 1 league

SQUARE OR SURFACE MEASURE

144 square inches (sq. in.) = 1 square foot (sq. ft.)
 9 square feet = 1 square yard (sq. yd.)
 80½ square yards
 or
 272½ square feet } = 1 square rod (sq. rd.)

160 square rods	= 1 acre (A.)
640 acres	= 1 square mile (sq. mi.)
1 A. = 160 sq. rd.	= 4840 sq. yd. = 43,560 sq. ft.
1 mile square	= 1 section (sec.)
36 miles square (36 square miles)	= 1 township (T.)

Roofing is usually estimated by the square (100 sq. ft.).

Shingles are packed 250 to a bunch. Allowing for waste, 4 bunches cover a square when laid 4 in. to the weather.

Clapboards, usually 4 ft. long and 6 in. wide, are packed 25 to a bunch. When laid $3\frac{1}{2}$ in. to the weather, a bunch covers 25 sq. ft.

Laths, 4 ft. long and $1\frac{1}{2}$ in. wide, are packed 50 or 100 to a bunch. Usually laid $\frac{1}{2}$ in. apart. Allowing for waste, a bunch of 50 covers 8 sq. yd.

CUBIC OR VOLUME MEASURE

1728 cubic inches (cu. in.)	= 1 cubic foot (cu. ft.)
27 cubic feet	= 1 cubic yard (cu. yd.)
1 cubic yard	= 1 load of earth, sand, etc.

Brick Masonry. Ordinary bricks are 8 in. by 4 in. by 2 in. 22 bricks with mortar occupy 1 cu. ft.

Stone Masonry. Stone work is estimated by the cubic foot, cubic yard, or by the perch, $24\frac{1}{2}$ cu. ft. In practice, 25 cu. ft. are called a perch.

WOOD MEASURE

16 cubic feet	= 1 cord foot
	(cd. ft.)
8 cord feet	} = 1 cord (cd.)
or	
28 cubic feet	

Wood for fire purposes is usually cut into 4-ft. lengths. A pile of 4-ft. wood 8 ft. long and 4 ft. high is a cord.

BOARD MEASURE

Lumber is usually sold by the board foot.

A board 1 foot square, or its equivalent, and 1 inch thick is a board foot (bd. ft.)

In measuring lumber the thickness is regarded only when it exceeds 1 inch.

TIME MEASURE

60 seconds (sec.)	= 1 minute (min.)
60 minutes	= 1 hour (hr.)
24 hours	= 1 day (da.)
7 days	= 1 week (wk.)
2 weeks	= 1 fortnight
4 weeks	= 1 month (mo.)
30 days	= 1 commercial month
28, 29, 30, or 31 days	= 1 calendar month
8 calendar months or	} = 1 quarter
13 weeks	
12 calendar months	= 1 year (yr.)
365 days	= 1 common year
366 days	= 1 leap year
10 years	= 1 decade
100 years	= 1 century

OLD RHYME

Thirty days hath Sep-
tember,
April, June, and No-
vember;
All the rest have
thirty-one,
Save February alone,
To which we twenty-
eight assign
Till leap year gives
it twenty-nine.

Years divisible by
4 are leap years, ex-
cept centennial years
not divisible by 400.
All other years are
common years.

AVOIRDUPOIS WEIGHT

16 ounces (oz.)	= 1 pound (lb.)
100 pounds	= 1 hundredweight (cwt.)
20 hundredweight or	} = 1 ton (T.)
2000 pounds	
2240 pounds	= 1 long ton

The Avoirdupois ounce contains $437\frac{1}{2}$ grains.

The Avoirdupois pound contains 7000 grains.

A ton of hard
coal = 36 cu. ft.
(nearly).

A ton of soft
coal = 42 cu. ft.
(nearly).

A ton of hay =
450 cu. ft. to 550
cu. ft., according
to kind and how
well packed.

The long ton is used in wholesale transactions in coal, ores, etc., and in collecting duties at the custom house.

A register ton, used in measuring the entire capacity or tonnage of vessels, = 100 cu. ft.

A shipping ton, used in measuring cargoes, = 40 cu. ft.

TROY WEIGHT

24 grains (gr.) = 1 pennyweight (pwt.)

20 pennyweights = 1 ounce (oz.)

12 ounces = 1 pound (lb.)

1 lb. = 12 oz. = 240 pwt. = 5760 gr.

The Troy ounce contains 480 grains.

The Troy pound contains 5760 grains.

The carat (3.2 Troy grains, nearly) is used in weighing precious stones. It is also used to express the fineness of gold. 24 carats fine means pure gold; 18 carats fine means 18 parts pure gold and 6 parts baser metal.

LIQUID MEASURE

4 gills (gi.) = 1 pint (pt.)

2 pints = 1 quart (qt.)

4 quarts = 1 gallon (gal.)

81½ gallons = 1 barrel (bbl.)

2 barrels } = 1 hogshead (hhd.)

or } = 1 hogshead (hhd.)

63 gallons }

In estimating capacity of cisterns, etc.

1 gal. = 4 qt. = 8 pt. = 32 gi.

A gallon = 231 cu. in.

7½ gallons = 1 cu. ft. (nearly)

1 barrel = 4½ cu. ft. (nearly)

1 cubic foot of water = 62½ lb.

1 gallon of water = 8½ lb. (nearly)

1 quart of water = 2.08 lb. (nearly)

DRY MEASURE

The standard bushel is a cylindrical measure 18½ in. in diameter and 8 in. deep, and contains 2150.42 cu. in.

A stricken bushel used in measuring small fruits, oats, rye, wheat, etc., = 1½ cu. ft. (nearly).

A heaped bushel, used in measuring bulky fruits, apples, potatoes, corn in the ear, etc., = 1½ cu. ft. (nearly).

2 pints (pt.) = 1 quart (qt.)

8 quarts = 1 peck (pk.)

4 pecks = 1 bushel (bu.)

1 bu. = 4 pk. = 32 qt. = 64 pt.

APOTHECARIES' MEASURES

Used only in compounding medicines.

Weight

20 grains (gr.)	= 1 scruple (sc. or ℥)
8 scruples	= 1 dram (dr. or ℥)
8 drams	= 1 ounce (oz. or ℥)
12 ounces	= 1 pound (lb.)

Liquid

60 minims (m.)	= 1 fluid dram (m. ℥. or f. ℥)
8 fluid drams	= 1 fluid ounce (fl. dr. viij. or f. ℥)
16 fluid ounces	= 1 fluid pint (fl. oz. xvj. or O.)
8 pints	= 1 gallon (Cong.)

The apothecaries' ounce contains 480 grains.

The apothecaries' pound contains 5760 grains.

SURVEYORS' MEASURES

Length

7.92 inches	= 1 link (l.)
25 links	= 1 rod (rd.)
4 rods	= 1 chain (ch.)
80 chains	= 1 mile (mi.)
1 mi. = 80 ch. = 320 rd. = 8000 l.	
	= 63,360 in.

Surveyors generally use a steel tape 50 ft. or 100 ft. long, subdivided into feet and tenths of a foot

Surface

16 square rods	= 1 square chain (sq. ch.)
10 square chains	= 1 acre (A.)
640 acres	= 1 square mile (sq. mi.)
1 square mile	= 1 section (sec.)
36 sections	= 1 township (T.)
1 sq. mi. = 640 A. = 6400 sq. ch.	
	= 102,400 sq. rd.

ANGULAR OR CIRCULAR MEASURE

60 seconds (")	= 1 minute (')
60 minutes	= 1 degree (°)
360 degrees	= 1 circumference
69.16+ common miles or 60 geographic miles	$\left. \vphantom{\begin{matrix} 69.16+ \\ or \\ 60 \end{matrix}} \right\} = \begin{cases} 1 \text{ degree of latitude;} \\ 1 \text{ degree of longitude at} \\ \text{the equator} \end{cases}$

THE METRIC SYSTEM OF MEASURES

The Metric System of measures is used by many nations. In the United States its use is permissive, but not compulsory.

The primary unit of the metric system is the *meter*. (The meter equals 39.37 in., nearly.)

The decimal parts of each standard unit are indicated by Latin prefixes, thus: *milli*, meaning .001; *centi*, meaning .01; *deci*, meaning .1.

The multiples of each standard unit are indicated by Greek prefixes, thus: *deka*, meaning 10; *hekto*, meaning 100; *kilo*, meaning 1000.

In writing abbreviations of the units in each measure, fractional parts of the standard unit are indicated by small letters; multiples by capital letters.

In the following tables the units most commonly used are indicated by blackfaced type.

LINEAR MEASURE

The standard unit of linear measure is the meter.

10 millimeters (mm.)	= 1 centimeter (cm.)
10 centimeters	= 1 decimeter (dm.)
10 decimeters	= 1 meter (m.)
10 meters	= 1 dekameter (Dm.)
10 dekameters	= 1 hektometer (Hm.)
10 hektometers	= 1 kilometer (Km.)
10 kilometers	= 1 myriameter (Mm.)
1 centimeter = .01 of a meter; 1 kilometer = 1000 meters.	

SQUARE MEASURE

The units of square measure are obtained by squaring the units of linear measure. The standard unit is the square meter.

100 square millimeters (sq. mm.)	= 1 square centimeter (sq. cm.)
100 square centimeters	= 1 square decimeter (sq. dm.)
100 square decimeters	= 1 square meter (sq. m.)

100 square meters	= 1 square dekameter (sq. Dm.)
100 square dekameters	= 1 square hektometer (sq. Hm.)
100 square hektometers	= 1 square kilometer (sq. Km.)
1 square kilometer	= 1,000,000 square meters

In measuring land,

1 square meter	= 1 centare (ca.)
1 square dekameter	= 1 are (a.)
1 square hektometer	= 1 hektare (Ha.)

CUBIC MEASURE

The units of cubic measure are obtained by cubing the units of linear measure. The standard unit is the cubic meter.

1000 cubic millimeters (cu. mm.)	= 1 cubic centimeter (cu. cm.)
1000 cubic centimeters	= 1 cubic decimeter (cu. dm.)
1000 cubic decimeters	= 1 cubic meter (cu. m.)

In measuring wood,

1 cubic meter	= 1 stere (st.)
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CAPACITY MEASURE

The standard unit of capacity measure is the liter, which is equal in volume to a cubic decimeter.

10 milliliters (ml.)	= 1 centiliter (cl.)
10 centiliters	= 1 deciliter (dl.)
10 deciliters	= 1 liter (l.)
10 liters	= 1 dekaliter (Dl.)
10 dekaliters	= 1 hektoliter (Hl.)
10 hektoliters	= 1 kiloliter (Kl.)
1 centiliter	= .01 of a liter; 1 hektoliter = 100 liters.

WEIGHT MEASURE

The standard unit of weight is the gram; this is the weight of a cubic centimeter of distilled water at its maximum density. Our 5-cent piece weighs 5 grams.

10 milligrams (mg.)	= 1 centigram (cg.)
10 centigrams	= 1 decigram (dg.)
10 decigrams	= 1 gram (g.)
10 grams	= 1 dekagram (Dg.)

10 dekagrams	= 1 hektogram (Hg.)
10 hektograms	= 1 kilogram (Kg.)
10 kilograms	= 1 myriagram (Mg.)
10 myriagrams	= 1 quintal (Q.)
10 quintals	= 1 tonneau (T.)

1 centigram = .01 of a gram; 1 kilogram, commonly called a kilo (K.), = 1000 grams.

The following shows the interrelation of the different measures:

1 milliliter of water = 1 cubic centimeter in volume = 1 gram in weight.

1 liter of water = 1 cubic decimeter in volume = 1 kilogram in weight.

Approximate equivalents in United States measures:

1 meter	= $1\frac{1}{10}$ yd.	1 hectare	= $2\frac{1}{2}$ A.
1 kilometer	= $\frac{5}{8}$ mi.	1 stere	= $\frac{1}{4}$ cd.
1 liter	= $\frac{1}{16}$ qt. (dry)	1 gram	= $\frac{1}{16}$ oz. (avoir.)
1 liter	= 1 qt. (liquid)	1 kilogram	= $2\frac{1}{2}$ lb. (avoir.)

$$\begin{aligned}
 2^2 &= 4 \\
 3^2 &= 9 \\
 4^2 &= 16 \\
 5^2 &= 25 \\
 6^2 &= 36 \\
 7^2 &= 49 \\
 8^2 &= 64 \\
 9^2 &= 81 \\
 10^2 &= 100 \\
 11^2 &= 121
 \end{aligned}$$

$$\begin{aligned}
 12^2 &= 144 \\
 13^2 &= 169 \\
 14^2 &= 196 \\
 15^2 &= 225 \\
 16^2 &= 256 \\
 17^2 &= 289 \\
 18^2 &= 324 \\
 19^2 &= 361 \\
 20^2 &= 400 \\
 21^2 &= 441 \\
 22^2 &= 484 \\
 23^2 &= 529 \\
 24^2 &= 576 \\
 25^2 &= 625
 \end{aligned}$$

17⁺2

1968 and others

and others

67

16

507

1112

$$\begin{array}{l}
 \text{Base} \times \text{Rate} = \text{Percentage} \\
 \text{Percentage} \div \text{Rate} = \text{Base} \\
 \text{Percentage} \div \text{Base} = \text{Rate}
 \end{array}
 \left. \vphantom{\begin{array}{l} \text{Base} \times \text{Rate} = \text{Percentage} \\ \text{Percentage} \div \text{Rate} = \text{Base} \\ \text{Percentage} \div \text{Base} = \text{Rate} \end{array}} \right\} \begin{array}{l} \text{the} \\ \text{three} \\ \text{cases in} \\ \text{Percentage} \end{array}$$

$$\text{Cost} = \text{Base}$$

$$\left. \begin{array}{l} \text{Loss} \\ \text{Gain} \end{array} \right\} = \text{Percentage} \text{ } \%$$

